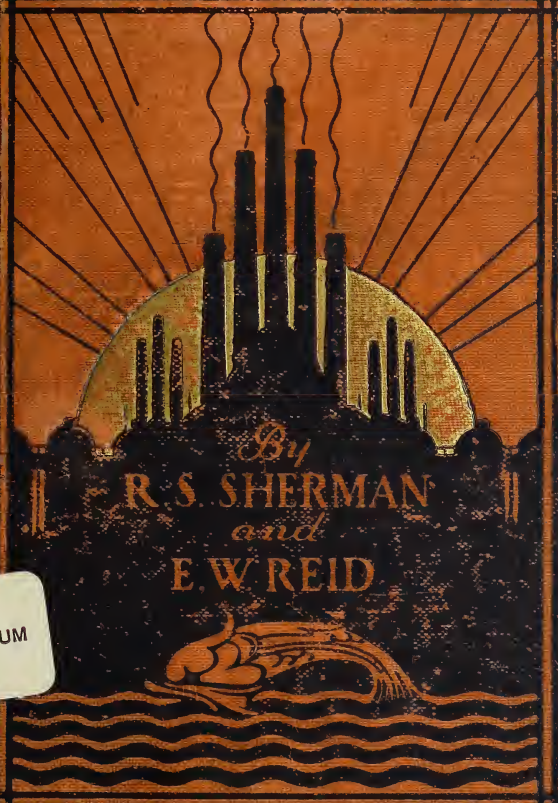
THE CANADIAN INDUSTRIAL READER



By
R. S. SHERMAN
and
E. W. REID

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THE
CANADIAN INDUSTRIAL READER

Province of Ontario Pictures

NIAGARA FALLS

THE CANADIAN INDUSTRIAL READER

By
R. S. SHERMAN
AND
E. W. REID

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ACKNOWLEDGMENTS

Thanks are due to E. B. Shearman, Esq., and to the Canadian Manufacturers' Association for the use of articles. Acknowledgment of copyright photographs is made under the reproductions. Most of the pictures ascribed to government departments have been obtained by courtesy of F. C. C. Lynch, Esq., National Resources Intelligence Branch, Department of the Interior, Ottawa.

THE CANADIAN INDUSTRIAL READER

I. TO THE TEACHER

ALL Canadian boys and girls should be brought to realise that, when school tasks are finished and vocations are chosen, each may find his or her useful sphere in sharing in the development of our young and prosperous country. When with worthy purpose our Government spends millions in encouraging people of other lands to immigrate to Canada, should we not so educate our own sons and daughters to appreciate the resources and opportunities of the Dominion, that they, our native-born, will make this land their home?

We have not painted a rosy picture of an easily won livelihood in any industry. They all have their hidden barrier-reefs where promising hopes are shipwrecked. The pioneers of Canada succeeded against great odds because they were industrious. They were a courageous and high-hearted people ennobled by labour; and the spirit of their splendid example must dominate our young until they too prove that the rewards of industry are to the industrious.

The field that we have chosen cannot be exhausted within the covers of a book. We have only suggested the approaches of an entrancing subject which reaches to the very roots of our daily lives. The pupils should make project-books of newspaper clippings bearing directly on Canadian industries, and should spend at least a year in making a careful survey of the local industries within a radius of a few miles from the school door.

Canada stands on the threshold of nationhood, with her future to be moulded by the thoughts and activities of the children of to-day, the citizens of to-morrow. May it be our

purpose as teachers to place nationalism above sectionalism by calling our people Canadians rather than English and French, by leading our topics beyond the boundaries of provinces, and by merging the rivalry of East and West into the more splendid desire for national unity.

2. THE DAWN OF INDUSTRY

With the illuminating eye of imagination, let us pierce the darkness that veils the unrecorded lives of our remote ancestors, and see in what activities they were engaged. Turning the spotlight of fancy upon our savage forbears we find that they faced the same problems, difficulties and dangers with which we are confronted to-day. Their bodily needs were the same as ours. Food, clothing, shelter and means of defence against his foes were the primal necessities of primitive man as they are of man in his present state of advanced civilisation. Our basic industries, such as agriculture, fishing, mining, lumbering and manufacturing, are chiefly concerned in satisfying these vital needs, and have occupied the hands and minds of men from early prehistoric times.

Let us not look with scorn or even with pity upon this primal man, this rough-hewn image, creation's masterpiece in the making, who is destined to be polished and perfected by the artistry of God. The potentialities of mighty empires are slumbering beneath that receding brow. The force that is to conquer and control Nature shines dimly through those brooding eyes. In the nerves and fibres of those gnarled fingers, that now grasp a club, are the impulses of creative effort that shall give to the world its richest treasures of music, literature and art.

This primitive man had to be physically strong and mentally resourceful. The forces of Nature, though the same then as now, were more menacing because less understood. Her inviolable laws have moulded and modified him until he has become what we see him to-day, a creature capable of shaping and controlling some of the mightiest works of Nature herself

"*From Nebula to Man*"

PREHISTORIC MAN

This is an imaginative reconstruction of the life of those days. Notice the brutal physique and personal appearance. What points of appearance, domestic equipment, and mode of life, show man's superiority to the animal?

—ruler of the world and having full dominion over "the beasts of the fields and the fowls of the air."

It has been through constant industry and earnest endeavour that man has attained to this exalted state. Yet his advance has not been an uninterrupted triumphal march. There have been periods during which he retrograded, owing to temporary lapses into habits of idleness and luxuriousness. Indeed, the fall of empires may be traced to these periods of decadence, and no nation has long endured that relegated its industrial life to a class of enslaved workers.

Primitive man was at first chiefly concerned with the pursuits of war and hunting. It was while engaged in these that he learned the value of co-operation, the banding together for mutual help in defence against a powerful foe or in overcoming the larger beasts of prey. Those people who were strong in war and skilful in the pursuit of game survived; the feeble and the inefficient perished.

There is no doubt that when man turned his attention to the fruits of the earth in addition to creatures of the chase, he took an important step in advance. At first he would confine himself to the gathering of wild fruits, nuts and seeds for immediate use. But there came the time when he discovered that some of these products could be stored for use in winter or to tide his family over a season of scarcity. Doubtless he learned by experiment that even soft fruits could be preserved if dried in the sun. The Indians of Canada and other parts of North America dried and stored in baskets such wild fruits as plums, service-berries, blackberries and wild raspberries.

The seeds of these fruits, scattered in the clearing in front of the cave or encampment, would germinate in soil made fertile by decayed refuse, grow into vigorous plants and produce finer fruit than the wild vines, thus teaching primitive man the value of cultivation. The same law would apply to the seeds of wild cereals that he ground up into meal. With no knowledge of the principles of natural or artificial selection, he would produce, in time, a superior variety of grain. Another step in advance would be taken when he decided to prepare natural clearings for the planting of these improved seeds. With his

first stirring of the soil by means of a sharp stick, agriculture began.

The keeping of domestic animals doubtless goes back to a very remote period. It is quite probable that the children of primitive man, who had the same interest in pups, kittens and calves as have the boys and girls of to-day, were responsible for the starting of the livestock industry. The young of animals slaughtered in the chase would send forth an irresistible appeal for help. Remembering his little ones at home, the cave-man, whose heart, unlike his club, was not made of stone, would capture the squalling waif, and a new pet in the form of a kid or a calf would for a time share the family bed.

When certain tribes turned their whole attention to the raising of stock, they were forced, in the search for new pasturage, to begin those annual wanderings which led to man's conquest of the waste places of the earth and the founding of distant countries and empires.

No one industry can advance without producing an incidental improvement or an increased activity in others. Manufacturing at first was confined to the crude shaping of clubs, spears and other weapons of war or of the chase. But with the advent of agriculture as a permanent industry, utensils and tools for various purposes were required. Men needed baskets in which to store their harvests, contrivances for crushing or grinding the grain, and pots in which to cook their food. They needed implements for tilling the soil and reaping the corn. In the course of time wood and stone gave place to metal, and the age of bronze and iron began. Mining and metallurgy were added to the list of human industries.

As man penetrated to regions of higher latitude but lower temperature, the need for warmer clothing became imperative. Clothing formed from the plaited or woven fibres of bark or other vegetable tissues gave place to garments of skins and later to those of wool. The arts of tanning, spinning and weaving were added to the list of man's useful industries. Each of them called for special processes or tools which taxed his powers of invention and added to his skill as a craftsman.

The art of navigation must have been acquired to some

extent at a very early date. For a long time, no doubt, it was limited to the aquatic feat, known and practised by most boys, of propelling a log or crude raft through the shallow waters of lakes or rivers. The hollowing out of logs into dugouts, in which operation our western Indians excelled, naturally followed. The use of sails was probably discovered when one of these early navigators lost his paddle in a storm and the wind blew him and his craft safely to shore. Great as his own daring seemed to him, however, the ancient Briton, venturing but a short distance from shore in his coracle, could not possibly dream of the mighty galleons and the gigantic liners that in successive ages would plough those waters and bear his posterity to unknown continents beyond the western seas.

3. THE GROWTH OF INDUSTRY

MAN by instinct is a climber. He has always been a climber. Even the Indian of the western plains sought the crest of a *coulée* or the top of a *mesa* from which to watch the movements of an enemy or the migrations of the buffalo herds. In flat forested regions he climbed the trees; on a rolling terrain he climbed the hills—always on the lookout for wider horizons, a broader vision.

From the earliest times man had "the seeing eye and the understanding heart." He was a close observer, as is evident from the skill displayed by the Indian scouts and other native trackers. Much that he saw, most that he learned by years of training, would have been of service to his fellow-men; but for ages there was no means of recording his observations, except by word of mouth to a few. His eloquence, his wisdom, died with him; his teachings were forgotten.

Man saw the need of permanent records. The hunter and the warrior who had performed great deeds wished their exploits to be known to their descendants, as well as to their children and fellow-tribesmen. It is true that the story-teller and the minstrel narrated and sang of these glorious deeds. In this

way, though often much changed, they would take their place among the tribal traditions. Out of them were sometimes woven strange myths and legends. But this did not satisfy man's craving to express himself, to leave some enduring record of his achievements. So he drew pictures on the walls of caves, on rocky headlands, and on the faces of cliffs, where all might see them. He carved his visions crudely in wood and stone. They pleased his fancy and became the totems of his family and tribe. But they did not fully express his thoughts. What he really needed was a written language that should fully record his deeds and observations, his dreams and visions.

Man the climber kept on, subconsciously seeking for the perfect form of expression. Before his ideal was attained many nations rose to exalted heights in the arts of civilisation, only to sink into utter oblivion, leaving no record of their accomplishments. However, the picture-writing of primitive man was a step in the right direction: it developed into the hieroglyphics of the ancient Egyptians, the cuneiform inscriptions of the Assyrians, and the complicated symbolic writing of the Chinese.

But it was left for the Phœnicians to construct a true alphabet from the Egyptian hieroglyphics. This invention gave to man for the first time a medium of written language so simple that the people as a whole could understand and use it. Other nations borrowed the Phœnician characters and modified them to suit their own language. The Greeks made good use of this new instrument of expression. The Romans borrowed their alphabet from the Greeks, and we borrowed ours from the Romans.

Now you may well ask: What has all this to do with the growth of industry? Well, it has a great deal to do with it. As we have seen, without an alphabet man was unable to leave any complete record of his observations, discoveries and thoughts. His wisdom, gained by his own unaided efforts, died with him. His descendants had to go through the same long, wasteful years of experimentation. But when the recorded wisdom of one age could be passed on to the next, man climbed from peak to peak of knowledge, until he reached the lofty summit on which he stands to-day.

Of course, we must remember that for many centuries man was forced to write or print his books by hand. The original work was often lost, and if any copies remained they frequently contained errors. Books were so scarce that few people could afford to possess them. The ability to read was confined to a limited number. Evidently something more than the power to read and write was required to stimulate study and to disseminate knowledge. It was the invention of printing, over the origin of which there has been much controversy, that gave an impetus to the New Learning and made possible the dissemination of knowledge throughout the world. The middle of the fifteenth century marks the dawn of a new day in the annals of education and of human enlightenment.

Man at last had the power to give full expression and wide publicity to his thoughts. But had he any thoughts that were worthy of expression? Most of the subject-matter contained in early books is of little practical value to us to-day. These ancient works were full of lengthy discussions on theological themes, but told us little about nature and life. However, they stimulated thought and helped to train a new class of scholars, not churchmen but laymen, whose eyes were focussed on this world instead of on the next, and who in their turn wrote books that recorded their observations. Scientific works began to appear, the works for which the world had been waiting. When once man directed his eyes to the marvellous truths of Nature, he could not be satisfied with the visions of cloistered dreamers. He found that these fascinating facts in the world about him were linked together in an endless chain. As soon as he grasped one vital truth, another was in reach of his hand. He discovered that governing the universe were immutable laws that he must obey, and mighty forces in Nature that he might use and in a measure control.

Some men were content to study Nature and record their observations without any hope of reward beyond the joy that comes to the explorer in undiscovered fields. But there were others who saw how they and their fellow-men might profit in a material way from their scientific discoveries. Applied science soon gave to the world many processes and inventions

that in time completely revolutionised the industrial life of the western world.

Every branch of science has contributed to man's advancement in the arts. Astrologers gave way to astronomers, who by their discoveries enlarged our conceptions of the earth and the universe and sent Columbus on his epoch-making voyage across the western seas. The alchemists with their futile dreams were swept aside by the chemists, whose investigations have conferred much good and a great evil upon the world—good in the fields of industrial processes, medicine and agriculture; evil in the form of high explosives and poison-gases used in modern warfare.

4. THE GROWTH OF COMMERCE

PRIMITIVE man was a jack-of-all-trades. He built his own dwelling; fashioned his own tools, weapons and utensils; made his own clothes and supplied himself and his family with food. Except when forced to combine with his fellow-tribesman for mutual defence, he led an individual and independent life. Trade and commerce were unknown. Still, even in those days, exchanges of a kind were made. A family who had a surplus of meat would share it with those who were less fortunate. They might not receive an immediate equivalent; but they cast their bread upon the waters in the expectation that it would return to them after many days.

The diversity of Nature's gifts to man, and the fact that they are not evenly distributed, led to the establishment of barter or trade, and eventually to commerce. We see this exemplified in the case of the aboriginal tribes of British Columbia. Long before the advent of the white man on this continent, the tribes of the interior were accustomed to meet the coast Indians at a common market-place for purposes of trade. The dried berries of the Soopolallie (*Shepherdia canadensis*) and other commodities were bartered for fish-oil, especially that of the oolichan, found only on the coast. Within the territory occupied

by certain tribes were often found beds of clay, flints, obsidian, native copper and other products that were essential to the primitive craftsmen. The coveted possession of these natural resources might in some instances lead to war, but were more likely to result in tribal barter.

But for the beginning of international trade or commerce we must study the history of Oriental peoples. Though trade received little encouragement from the early Egyptian kings, the vast stores of cereals grown in the valley of the Nile were exchanged for articles of beauty and luxury carried thither by merchants of other lands, and eventually a trade of considerable magnitude resulted. The Tigris-Euphrates valley was another area that produced a surplus of wheat. Lines of trade led into this region from Arabia, Syria and Persia.

Phœnicia first taught the world how a nation may develop and prosper by means of commerce and manufactures instead of by war and rapine. Her ships ventured boldly into what were then uncharted seas, in order to secure the raw materials which she required to support her extensive manufactures. She brought the first vestiges of civilisation to the shores of barbaric Britain, where she went for supplies of tin. On the north shore of Africa she founded a colony which became more powerful than the mother-country, and which shared the control of the Mediterranean first with Greece and later with Rome.

During the sway of these early empires, Phœnician, Persian, Greek and Roman, it is clearly demonstrated that trade and commerce flourished best under monarchs who ruled over wide dominions. Merchants were able to travel and send their goods from place to place in safety and free from the tribute imposed at the borders of petty kingdoms.

On the fall of Rome, commerce received a set-back from which it did not recover for many centuries. Europe was plunged into the "Dark Ages." Let us glance at a few of the high lights that fell upon the darkness enveloping the field of commerce during the centuries that followed.

The feudal system was inimical to trade and commerce, and little was accomplished along these lines until the system

itself began to disintegrate. The feudal village fostered a few trades such as that of the smith. The feudal towns, which grew in number and importance as the system itself declined, gave encouragement to manufactures of various kinds. Both artisans and merchants found it advantageous to band themselves together in guilds. The merchant guilds gave rise to the system of monopoly in trade. The craft guilds were the precursors of our trade unions. Both gave rise to abuses which hampered trade and restricted commerce.

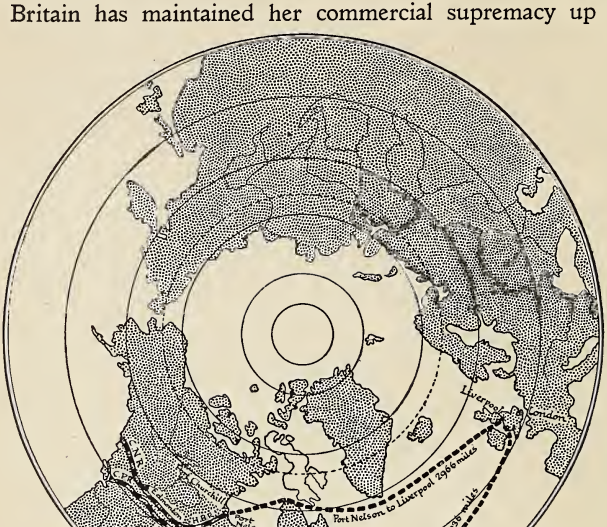
To facilitate the barter of goods, fairs were established. They were the prototypes of our markets. Sometimes these fairs lasted for ten days or more, and they afforded the people an opportunity to meet together, discuss the news of the world —the narrow world in which they lived—and trade their surplus produce for articles which they regarded as luxuries, but which we demand as necessities.

Sea trade in Europe, until the discovery of the mariner's compass, was confined to the coast. The Scandinavians, as the most venturesome navigators, took the lead in this enterprise. The Crusades, as we might suppose, stimulated the long-neglected sea trade of the Mediterranean. Slaves, unfortunately, formed the chief article of commerce for many years. But Western Europe had cultivated a taste for savoury foods, and from the East Indies were imported pepper, cloves, nutmegs, cinnamon, mace, ginger and other delectable commodities. Among articles of adornment or for use as wearing apparel were introduced precious stones, cotton and silk. Out of this trade with the East sprang the commercial supremacy of such cities as Venice, Genoa, Florence, Marseilles and Barcelona.

But on the opening of the water-route to India by Vasco da Gama and the discovery of the New World by Columbus, the centre of commerce shifted westward. Both Portugal and Spain enjoyed a brief period of industrial activity and trade expansion. Owing to bad government and lack of intelligent enterprise, these countries soon lost their proud position in the world of commerce. Britain became mistress of the seas, not only by the spectacular overthrow of the Spanish Armada, but by her reputation for fair dealing, the business enterprise of

her people and her sound colonial policy. A close rival was Holland, who, though stripped of all her possessions in North America and Africa, has managed to hold her own in the East Indies and to obtain a fair share of the world's carrying trade.

Britain has maintained her commercial supremacy up to



MAP TO SHOW WHY THE DISTANCE FROM PORT NELSON TO LIVERPOOL IS LESS THAN FROM NEW YORK TO LIVERPOOL

the present time. In addition to the causes already assigned, she owes much of her success to her geographical position and her natural resources.

In the inevitable shifting of the centre of civilisation to the West, commercial supremacy will undoubtedly pass to nations of the New World. When that time comes, Canada, possessing as she does such vast natural resources, so many excellent harbours and unrivalled facilities for transcontinental traffic, should hold a commanding place in the world of industry and commerce.

5. INDUSTRIAL CANADA

WHETHER we dwell in towns, in cities, or on farms, whether we inhabit the mountains or great rolling plains, or even roam on the seas, our living comes from the earth, and the nature of the country we inhabit determines how we shall live. It is the law of life that we must earn our bread by the sweat of our brows; for Nature has placed the trees on the high hills, the minerals in the solid rocks of the mountains, fishes in the sea, and plant food in the soil; she causes the storms of winter, the rains of summer, seed-time and harvest. She provides us with all our needs, but we must, by unflagging toil, adapt them to our use, and this striving to live, this exercise of brain and muscle, makes us what we are. If Nature is too kind, as in the balmy tropics, man does not exert himself to develop his highest powers: if she is too severe, as in the frozen north where the mantle of snow rests heavily the year through, man can barely survive. It is in countries where one must work hard in summer to provide for life's needs during winter, that civilisation has fostered splendid nationhood and sterling character.

In this great Dominion, the land of our birth or adoption, has Nature been generous with her gifts for living, so that a great nation may dwell within our borders, or are our natural resources too far north to be developed? Let our country, three thousand miles wide, be reduced to the size of a small map, that we may study its surface and compare its mountains and plains, rivers and lakes, hills and valleys with the rest of the continent, to find how well our country is situated for human habitation.

Canada has formerly suffered greatly in comparison with the United States. While these countries are of about the same size, well over one hundred million people live south of the border and less than one-tenth of that number have made their homes in our land of the north. When the Pilgrim Fathers came to New England, they found themselves on a rock-bound sea-coast, hemmed in by mountains. But when once they burst the barrier of the Appalachians, they found one of the largest

fertile lands on earth, the great Mississippi Valley, awaiting their settlement. The gold rush of 1848 brought their settlers to the gates of the Pacific, and there they discovered a land with no winter, fruitful and inviting. Surely a country that could grow sugar-cane in the south and wheat in the north, apples in the east and oranges in the west, and that could supply land for the asking, would not wait in vain for settlers! And they came by the hundreds, thousands and millions.

How much more difficult has been the development of Canada! When the French settled in the valley of the St. Lawrence; when the United Empire Loyalists cleared the forests on the rich lands of the Ontario peninsula; when the Scottish immigrants and Loyalists made their homes in the fertile valleys by the sea, pioneering ceased, for the West was only penetrated by traders who brought back the pelts of wild animals. The Great Central Plain of the States narrowed in Canada to the valley of an ice-bound river. The Canadian Shield, an uninviting land of seemingly worthless waste, set its rocky face to the shores of Huron and Superior, and barred the way for a thousand miles from east to west. The Rocky Mountains north of the boundary, completely shutting off the few settlers of the Fraser Gold Rush of 1858, rose higher and higher in serrated peaks until they were lost in the eternal snows of the Arctic.

Before Confederation, Canada was a group of farm-lands in the settled valleys of the East. There were few manufactories and a scant market for goods. Expansion was at a standstill. Then, with Confederation and the purchase of the West from the Hudson Bay Company, there grew a great desire to open up Canada from the Atlantic to the Pacific. It was the task of giants, but the fathers of confederation were men of stature and vision. They planned to link the East to the West with bands of steel. In the mind's eye they saw cities dotting the green prairie, tunnels boring through the mountains, long trains of wheat and cattle crossing the plains, huge engines stealing round the curved bases of the towering mountains and over the high trestles above foaming rivers, and great ships on both oceans leaving and making Canadian ports. Each did his work well: Macdonald, Tupper, Stephen, Strath-

George A. Cornish

PHYSICAL DIVISIONS OF CANADA

What are the four main divisions? In which is the clay belt?

cona, Van Horne and Shaughnessy. The greatest engineering work up to that time was completed: the building of the Canadian Pacific Railway.

Then the miracle of Canada began, a slowly unfolding story of wonderment. Even as the finest gold is hidden in the deep rocks of mountains, and rewards only the most patient search, so the austere and forbidding Northland at last yielded its treasures to the strong and willing seekers.

A stern climate produces the best type of people: it also brings forth the finest and hardest wheat. When it was found that the prairie was too cold for the Red Fife wheat, a new variety, the Marquis, was produced, which would ripen so far north that Western Canada now exports more wheat than any other country in the world.

With the great demand in the United States for paper, the spruce forests of Quebec and Ontario and the great conifers of British Columbia, which barred the progress of settlers, are now being ground into pulp, and these waste lands of Canada are making her the most important country for paper.

The Canadian Shield is a storehouse of minerals, Alberta has one of the greatest supplies of coal in the world, and British Columbia has untold mineral wealth. As new and greater uses are found for machinery and all articles made from metals, so the world must open up her last treasure-chest of minerals in the rocky wastes of Canada.

The glacier-bound mountains of Canada feed innumerable streams. These swell to mighty rivers, often barred in their swift courses to the sea by rocky escarpments over which pour foaming rapids. These obstacles to navigation have been overcome by canals where necessary, while the waterfalls are being harnessed to form hydro-electric power for turning the wheels of industry. Canada's water-power, or "white coal," will make her in time a great manufacturing country.

So the frosted prairie-land, the hilly spruce country, the forbidding mountains and the barrier rapids, rejected by the first nation-builders, are rapidly becoming the four corner-stones of our industry. This is the miracle of Canada.

Canada has the most extensive fishing-grounds in the world.

Raw sugar is the most important import as regards bulk, amounting to more than a billion pounds. It is manufactured at Dartmouth (Nova Scotia), Montreal and Vancouver.

Canada ranks next to the United States, which is first in the amount of life insurance *per capita*.

Raw materials which cannot be produced in Canada, as rubber and sugar, enter free of duty.

The Bank of Montreal is the oldest bank in Canada, having been established in 1817.

In 1858 the currency system was changed from English money to dollars and cents.

Outside of fire insurance the most important is automobile insurance, for which the owners pay over seven million dollars a year. Hail insurance comes next, for which the farmers pay more than five millions.

Linoleum, dynamite and gramophone records are produced from a flour made of wood.

Canada's export of newsprint paper is greater than that of all the other countries of the world combined.

6. AGRICULTURE

In almost every country agriculture is the most important industry, because food is our first and constant need. We may repatch our clothing, wear our shoes a month longer or go barefooted, but every day we must be fed and our very lives depend upon the bounty of mother earth, aided by sunshine and showers, to provide us directly or indirectly with sustenance. This need we all realise; but too often we are ignorant of the conditions of food-production. The rainy day that mars a picnic for the dwellers in a city and causes such bitter complaint, will repay them with cheaper and more generous meals before the year is ended. Being thus dependent on the soil, should we not know something of the farming industry which is the backbone of the country?

We are all farmers at heart, for agriculture was the first

great industry, and with the awakening of Nature in the sprin the call of the soil is in our blood as part of our ancestral inheritance. Whether the farmer is growing a crop or caring for the domestic animals, his task should be inspiring because he is working in unison with Nature. He is close to the mystery of life, directs his action to the pace of the laws of Nature, and is awed by the outcome of causes beyond his human comprehension. Living out of doors the farmer leads a natural and healthful life, and many of our Canadians, who have attained to the greatest success, spent their early days on the farm.

There are many disadvantages in farming for those who wish to secure a livelihood with the least effort. In the summer season, when the weather is fine, the farmer must toil from early morn until the fall of darkness; for planting season, hoeing, haying and harvest follow one another in swift succession. If the fruit-trees are too venturesome, the late spring frosts freeze the blossoms and the trees are idle for another year, while taxes, interest-money and other expenses continue unabated. The wheat ready for the harvest may be cut down in an hour by hailstones or ruined by the early autumn frost. Tuberculosis may cause a herd of cows to be marked for slaughter or distemper carry off a band of horses. The canker-worm, wireworm, wheat rust and codling-moth give anxiety, each in its season. Only after constant care and the most watchful anxiety are the farmer's efforts crowned with success.

To those who crave the constant companionship of human society, rural life has no appeal. While the pioneer farmer is interested in watching the ever-changing appearance of his crops and stock and in accomplishing his necessary work, his wife, alone in the inconvenient farm-house, may often envy her sister of the city with running water and electricity in the home and society and amusements without.

Yet we are fortunate in having a sturdy stock with the true pioneering spirit, who are willing to battle with the elements and wrest their living from the stubborn soil. To such as these agriculture in Canada offers unparalleled opportunities. In 1925 the average income of the Canadian farmer was $2000, the highest in any land. So the strong, the willing and the

Department of the Interior

AGRICULTURE IN CANADA

Where is most wheat grown? Is there more fruit in B.C. or in Ontario? Find three provinces in which dairying and mixed farming are carried on extensively.

ambitious from foreign countries are seeking passage to our Dominion, where true pioneers are certain to succeed.

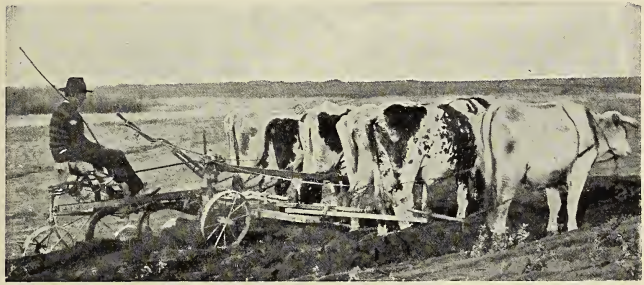
To begin a new farming venture means a considerable expenditure. If an improved farm is purchased, a large cash payment is necessary, while money must be found for stock, machinery, seed and furniture, and no money is available until the crop is harvested. When wild land, however cheap, is secured, capital will be needed for buildings, and there is no prospect for a crop until the second year. But extensive credit is given the farmer and the energy of the man himself is looked upon as the best security. There is cheap land to-day in the West, near good roads and transportation; there are homesteads for the asking in the Peace River country; and four-fifths of the arable land in Canada is not yet broken by the plough.

The agricultural industry depends upon suitable soil and climate, and many sections of Canada are handicapped in regard to these. The fertile soil in the delta of the Mackenzie will never be cropped because it is frozen most of the year. The rocky lands of our mountain-tops will never be farmed because they do not possess sufficient soil. However, much of our best soil is obtained from these very cliffs. Granite is called the mother rock of the earth because it contains feldspar, which is ground by the glaciers of the mountains, is carried as sediment in the raging torrents of the rivers, and is spread out, in the course of ages, to form the clay soil of broad river valleys. The clay that was carried to lakes and seas in the distant past remained when a change in the earth's surface drained off the water, such fertile prairie-lands as those of Canada having been thus formed. This clay is the soil best suited for plant growth; so we look for good agricultural lands where great river valleys and plains are found and where the climate is not too severe for the maturing of crops. The beaver in building his dams across small streams caused lake bottoms in narrow valleys. These have added materially to the rich farm-lands of Canada's plains and river valleys.

Occupying the most northerly part of the continent, Canada has the advantage of her colder climate producing a superior quality of farm-products. Canadian hard wheat sets the standard

for the world; her fruits have a colour, firmness and flavour that win in every competition; while her cattle, cheese, butter and bacon, considering the distance they travel, are the best that reach the British market.

The agricultural industry has two main branches: the growing of field crops for food and fodder and the rearing of live stock. In Canada the former is more important and, of the field crops grown, wheat is by far the most valuable, and the three great prairie provinces are destined to become the bread-basket of the world. A country that produces field crops of superior



Canadian National Railway

OXEN AT WORK IN CANADA—THE OLD WAY
Six oxen turn two furrows.

quality is certain of a market for seeds, and Prince Edward Island, "The Garden of the Gulf," has developed an important industry in the growing of seed oats, certified potato seed and browntop grass seed for golf courses. Each year sees an extension of the seed crop in every province. Flax for fibre is successfully grown in Ontario, Nova Scotia and British Columbia; sugar beets in Ontario and southern Alberta, and hops in the Fraser Valley. The Annapolis Valley, Niagara Peninsula and Okanagan Valley are famous for apples and allied fruits, while small fruits that ripen later in Canada are finding a ready market in the large cities of the United States.

Ontario has long led the rest of America in the breeding of thoroughbred stock. These splendid animals have formed the

nucleus of the ranching herds of Alberta and of the dairy stock of Eastern Canada.

Even before the farmer has grown his crop or raised his stock, he must be certain of his market. The finest apples, wheat, butter and beef are of little use to the farmer if he cannot find a sale for his products. Canada is largely an agricultural country with few large cities, so the commodities of the farm

Canadian National Railway

STEAM PLOUGHING IN CANADA—THE NEW WAY
One engine turns six furrows.

must be consumed in other lands, and the two countries that buy most of our food products are Great Britain and the United States. England is the greatest manufacturing country in the world, and most of the food for her forty millions of people is purchased from other countries. From Canada she buys wheat, beef on foot, butter, cheese, bacon and apples. The United States now has more than half of her people working in cities, and certain foods have reached a price there that will allow the Canadian farmer to pay the duty and supply the demand. So hard wheat for milling, beef, milk for the big Eastern cities, and late-ripening fruits, find a profitable market south of the

border. The Orient is creating a demand for wheat flour, tinned milk and canned goods, which Canada is in a position to supply. When we consider the great area of our country and the scattered nature of its settlements, when we estimate the great distances that separate us from our markets and realise the bulk and weight of farm exports, we comprehend the need of good transportation facilities by rail and keel to ensure the delivery of our products in foreign ports. The two greatest railroad and steamship companies in the world are at the service of the Canadian farmer.

Great changes have taken place in rural life during the last few years. The inventive genius of the world is revolutionising the lives of the tillers of the soil. Modern machinery is helping to remove the drudgery of farm life. The gasoline engine, the electric dynamo, the tractor and the automobile have lightened labour and have brought the city closer, while the telephone and radio have removed the loneliness from the great open spaces.

To be a successful farmer one must be willing to work hard; he must study the markets and know the trend of events; he must keep careful records that he may profit from experience; he must know what he can produce best; and he must see a crop in the future when his present one is a failure. The glory of the farmer's calling is that he works with Nature in her temple and passes on her gifts to those without.

7. THE HOMESTEADER

One hundred and sixty acres of good land free! That was the magnet that drew settlers to the great West, just as the desire for free land led the pioneers of earlier days to settle in the virgin forests of Ontario and the Maritime Provinces. It is the natural ambition of all people to own land. In the old days in Europe the all-powerful nobles seized the land and leased it to the peasants, who became their vassals. In many places in that continent to-day the landlord system is still prevalent. The landlord, or Seigniorial Tenure, system was established by the French in Quebec, but since 1854 the farmers of that

province have been able to buy and own their own land. But the rest of the continent has always been the land of the free, because free land was to be had for the taking, and this fact has played a large part in attracting colonists.

When Rupert's Land, our Canadian West, was purchased by the Dominion Government from the Hudson Bay Company in 1869 for $1,500,000, it was gradually surveyed and laid out for settlement in a manner befitting a great level country. By 1885 the area between Winnipeg and the Rocky Mountains was largely surveyed into sections, townships and ranges. The unit of measurement was the section, or square mile. A square block of thirty-six sections was called a township, and a group of townships extending from the international boundary as far north as the survey went was known as a range, which was numbered in order west from five meridians, the first being in Manitoba. This system is very exact and lends itself to easy identification. If a farm is advertised for sale as N.E. $\frac{1}{4}$ sec. 18 t. 9 r. 9 w. of 2, it is readily located on a Government map or from Waghorn's *Guide*. It is fifty-seven miles north of the boundary and fifty-nine miles west of the second meridian, which is in Saskatchewan.

Free land is offered to the settler on the prairie in the form of a homestead which comprises 160 acres of land, or one quarter section. A homesteader registers at the Dominion Lands' Office for his homestead by paying a fee of ten dollars. He must be eighteen years of age, a British subject, or, if not, he must declare his intention to become one. The homesteader must erect a habitable house on the land and reside there for at least six months during each of three years, and at the end of that time he must have thirty acres broken, of which twenty must be cropped. Having thus fulfilled his homestead duties he can then apply for a patent and receive a deed to his land. Most of the settlers on the prairie to-day homesteaded their first land, and within the past twenty years so many homesteads have been taken, that few are now left outside of the Peace River country of northern Alberta and British Columbia. Not all land was open for homesteads, as the Canadian Pacific Railway was given twenty-five million acres within twenty

miles of their main line. The Hudson Bay Company reserved one-twentieth of all the land south of the North Saskatchewan; each homesteader could pre-empt a quarter section adjoining his own at three dollars an acre, and large areas were reserved for the Indians.

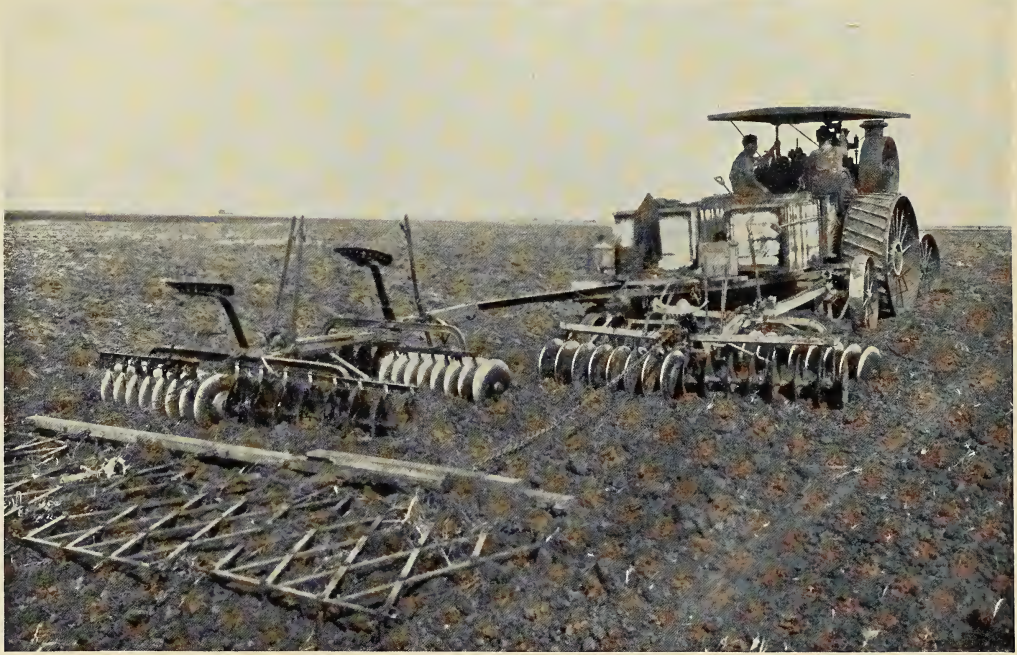
John Donaldson, a prosperous farmer on the Saskatoon Plains, harvested a wheat crop last year worth over ten thousand dollars. He came from Ontario in 1905 at the age of twenty and began as clerk in a store in Battleford. He was a son of the soil and but awaited a favourable opportunity to register for a homestead. Someone told him of a good homestead that was thrown open south of the town, so, as the news had spread, he thought it wisest to rush to the registry-office and risk ten dollars on the venture. Others seemed to be hurrying in that direction as well, so Donaldson cut through a lot, climbed a fence and arrived at the registry-office ahead of them. But a minute before he arrived the door was closed for the day, and the next was Saturday, a holiday, so the office would not open until Monday morning. By this time a long line was forming behind him, so he decided, as it was early spring, to camp on the steps until Monday morning. Many others also planned to remain with the hope that those ahead would tire and leave. Friends brought food and bedding and the line-up remained until Monday morning. We can only hope that all of those eager seekers for land afterwards procured as good a homestead as did Donaldson, and are now as prosperous.

The homesteader usually worked for a farmer during the summer, and put in his residence duties during the winter until he was able to secure an outfit of his own for breaking. "Batching" was the word that signified the slight household duties that the homesteader undertook. Only hunger would drive him to cook, and there was no incentive whatever for washing dishes. Prairie chickens, wild ducks and geese often graced his board, tinned goods formed a relish, but pork and potatoes with dispirited biscuits were the main fare. Even when he spent the whole year on his land, he seldom cared for a vegetable-garden or milked a cow. Trivial duties never interested him in a land which stretches big and wide to the horizon.

The "bronco" belongs more to the days of the homesteader than to the present, and is of considerable interest because it inhabited the prairie before the settlers came and was an animal of the greatest service in the pioneer work that led to extensive wheat farming. There were no horses in America when the white man came, but some of these useful animals, brought over by the Spaniards, were allowed to escape and in time developed a wild horse, the bronco, which spread far north on the Great Central Plain. When captured and tamed, these horses were of great use to the early settlers, for, although small, they were tough and wiry, and when turned loose in the autumn they pawed the snow and lived on the dried prairie grass beneath. They have been replaced by heavier draught animals from the East, but for saddle and driving purposes and for helping to turn the first stubborn sod hardened by the tramp of numberless herds of buffaloes, the bronco is kindly remembered by the homesteaders.

8. THE WHEAT FARM

It is the middle of April on the prairie. Spring is in the air, wild geese are honking north to lone nesting-grounds, but winter has not released its grip on the land, for snow lies in dreary patches and the ground freezes at night. How anxiously the farmer watches every turn of the weather for the hopeful signs of moisture and warmth! His dream of an earthly paradise is an early spring, the wheat seeded, and then gentle showers. For from the day that the wheat is seeded, in the rich soil, one hundred and ten days are needed ere the golden harvest is ready for the binder, and before that time there may be perilous nights, when the wind drops and the full moon rides high in a cloudless sky, when there is frost rime in the place of dew and the wheat in the stook is frozen and shrivelled. All is in readiness for the moment when the ground is free of snow and the soil is dry enough to fall and cover the drill. The plumpest seed, over sixty pounds to the bushel, if possible, is measured out, a



Department of the Interior

DISKING AND HARROWING BY STEAM TRACTOR

bushel and a half to the acre, is winnowed free of chaff and foul seed, and is treated with blue-stone to kill the rust spores. Farm machinery, which may have had to stand out during the winter, is carefully overhauled, harnesses are oiled, and the horses are put in prime condition, all awaiting the hour for the seeder to start. At last seeding begins, and two teams of four horses each may replace each other on the seeder from early morn until dark, for farm machinery is very expensive and a seeder is only in use for a few days in the year. When the wheat comes up it is in even rows about four inches apart, because the drills of the seeder make furrows into which the seeds run, and a chain behind covers over the soil.

If there is sufficient moisture, the wheat appears above ground in a few days. It then stools or throws out a number of extra stems, each one of which may produce a head. Wheat is seeded on three different kinds of land: breaking, stubble and summer fallow. During the course of time, the grass roots are so embedded into the soil that breaking the prairie or ploughing it for the first time is a very difficult process indeed, requiring the power of at least three sturdy horses to turn a single furrow. June is the month for breaking and the land is afterwards thoroughly disked and pulverised with harrows. When seeded the following spring, breaking is almost certain to produce an excellent crop. After land has been cropped only one year, if there is not time to plough it either in the autumn or spring, the stubble may be burnt and the land seeded. This is called a stubble crop and yields usually a light harvest, because it is easily affected by dry weather and contains a certain percentage of weeds.

Every third summer the land is allowed to lie idle or fallow. It is ploughed early in June before the weeds go to seed, and it is harrowed as much as possible during the summer. This kills the weeds and conserves the moisture. The next year summer fallow produces a splendid crop, if conditions are at all favourable. The benefit of summer fallowing was discovered in a very interesting way. Angus Mackay, head of the Indian Head Industrial Farm for so many years, has often been called the "grand old man" of Saskatchewan, because of what he has

done to improve agriculture all over the West. In 1885 he was a prosperous farmer, when the Saskatchewan Rebellion broke out. That spring he was prepared to seed an immense area, but the Government commandeered his men and teams for transporting the army supplies north, where soldiers were being hurried to suppress the Riel Rebellion. Angus Mackay was left alone with his unseeded acres and nothing to do but wait for the seeding time of another spring. But such a thrifty farmer as he could not watch the weeds grow, so he got a team and kept the idle land worked. Another spring came round and the wheat was seeded, but what a trying summer! The rains of June failed to come even in July, and scorching winds nearly blew the seeds out of the ground. All over the country a crop of about two bushels to the acre; but on Mackay's fallow land there grew a wonderful crop, thirty bushels to the acre. And so the farmers learned the benefit of summer fallow.

After the wheat is seeded the farmer can do no more; he has done his share, and the success of the crop depends upon the weather. Sufficient rainfall must occur in June and in July to ensure growth. The deep clay soil of the Canadian prairie is particularly adapted for wheat, and the Red River Valley lands have produced good crops for seventy-five years without fertilisers. The dry and cool weather, after the grain heads, produces the hardest and finest wheat in the world, but sometimes extreme dryness retards the growth of straw and the filling of the heads. But in spite of this drawback, land valued only at $30 an acre may produce its purchase price in one year, with thirty or more bushels to the acre, worth over a dollar a bushel.

More and more the farmer is ensuring his income by raising stock or by dairying as a side-line, and food must be provided for the cattle after they are brought in from pasture. A wheat farm comprising a section requires from twelve to fifteen horses to work it successfully, and these also must be fed through the long winter. Timothy and clover, the two great fodder grasses for stock in Canada, can be grown in Alberta and Manitoba and will in time be successfully grown in Saskatchewan. Alfalfa is increasing its hold, sunflowers grow well in all

three provinces and make a valuable ensilage crop, while oats will produce from fifty to one hundred bushels an acre, and when cut green in sheaves are better than hay for wintering horses and cattle.

And now having been anxiously watched by the farmer, forgotten by the hail-clouds and nurtured by the summer rains, the fields of wheat are ready for the harvest. The four-horse binder, cutting its twenty acres a day, travels steadily in lessening tracks around the huge field. A fresh relay of horses and supper

Department of the Interior

CUTTING GRAIN ON THE PRAIRIE

How many machines are engaged in cutting?

for the driver are brought to the field, and the rising moon sees the binder still going. The modern binder is the very perfection of machinery. It cuts and gathers every stalk of wheat on the platform, turns the heads all the same way, rolls the grain into sheaves, binds these tightly with twine, ties a knot, cuts the string and deposits the bundles of sheaves in rows on the field. Two men are required to follow the binder and stand up the sheaves in the stubble in stooks. For this extra work of shocking the wheat men are rushed to the prairie in harvest excursions on special trains at greatly reduced fares. They stay later to assist in the threshing and many become permanent settlers.

October is the month of threshing, and then the prairie has a glory all its own. It is the time of hazy Indian summer days, frosty nights, wonderful blood-red sunsets, and, stretching to

the horizon, yellowed fields burning into gold. The big traction-engine, drawing its separator and caboose for the men, steams into the field. The separator is drawn up in the field of stooks beside the movable granary, the water-wagon starts for a slough or well, the belt is carried out, the engine backed round, the fireman gathers his straw for fuel, the neighbours come to assist in the hauling with their stook-wagons, the belt is slipped on, the engine blows for water and then for sheaves, the wheels begin to move, the separator shakes its dusty sides while its knives reach for the sheaves travelling on the carrier, and a steady stream of the world's finest wheat pours into the granary.

The wheat crop of the West in 1926 was well over four hundred million bushels, and was worth over half a billion dollars to the country. Saskatchewan leads in wheat production, and in one year its grain is worth more than all the gold that the Yukon ever produced. Western Canada will reach the billion-bushel mark and still have large areas untouched by the plough.

From seed time to harvest the progress of the wheat is eagerly watched by all the people of Canada, for a successful crop means enlarged buying power that affects every part of the country. The story of wheat is the story of hard work, anxiety and often great disappointment, but the grain-fields of the West are an epic of achievement that yearly express in waving fields of gold the bounty of Nature to those that have vision, perseverance and faith.

9. THE STORY OF MARQUIS WHEAT

In 1892 a little packet of seeds came through the mail to the office of the Experimental Farm at Ottawa. It had been mailed from the Government Farm at Agassiz, British Columbia, and might very well have had a special train and an armed guard to convey it across the continent, for from the output of those few kernels of wheat Canada has added each year millions to her wealth. This little mail-package, worth millions of

dollars, arrived at its destination with no flourish of trumpets. The postman threw it on the office table and two farm boys happening to drop in used it as a baseball and, unaware of its great value, began hurling it at each other. Finally it became lodged on top of a cupboard, where it stayed. There is a long and interesting history to the little sack of seeds, whose descendants last year measured up to three hundred million bushels of good wheat.

The story should begin with William Saunders, the Luther

Department of the Interior

A FIELD OF REGISTERED MARQUIS

Burbank of Canada. He was a druggist who had a penchant for growing new plants. He specialised on the gooseberry and developed several new varieties of that plant, but he always had the desire to see how many different plants could be grown on the new Western prairie in defiance of the cold climate. And the chance was granted him, for the Government chose him, in 1886, to start experimental farms in Canada. Instead of seating himself before a roll-top desk in Ottawa and hiring a secretary to keep people from seeing him, he started for our West and with a horse and buggy drove hundreds of miles over the prairie, asking the settlers what they needed most. And the

cry was: "We want a wheat that will ripen ten days sooner than the Red Fife." So William Saunders sent all over the world for early ripening wheats. In the Himalayas he found the Hard Calcutta, which ripened early but gave a yellow flour. The white race wanted a white bread, so what was to be done? Saunders had the idea; he would unite the Red Fife, with its white flour, with the Hard Calcutta, the early yielder. He might get a yellow flour and a late maturing wheat, but he might—just possibly—get a white flour from an early ripening

Department of the Interior

MAKING A CROSS IN WHEAT

wheat. It would mean fifteen years' work to be sure of success or failure; but the great man never counts on failure—he expects to succeed!

Now William Saunders was growing old and knew he might not live to complete his work. So, after having given his sons a good education, he interested them in carrying on the great project. Dr. Charles Saunders worked with his father in Ottawa, while Dr. Percy Saunders travelled across Canada, carefully dusted the pollen of the Red Fife on the pistil of the Hard Calcutta, and sealed up the little flowers with the hope that the result would be a new kernel of wheat. Only at Agassiz was the

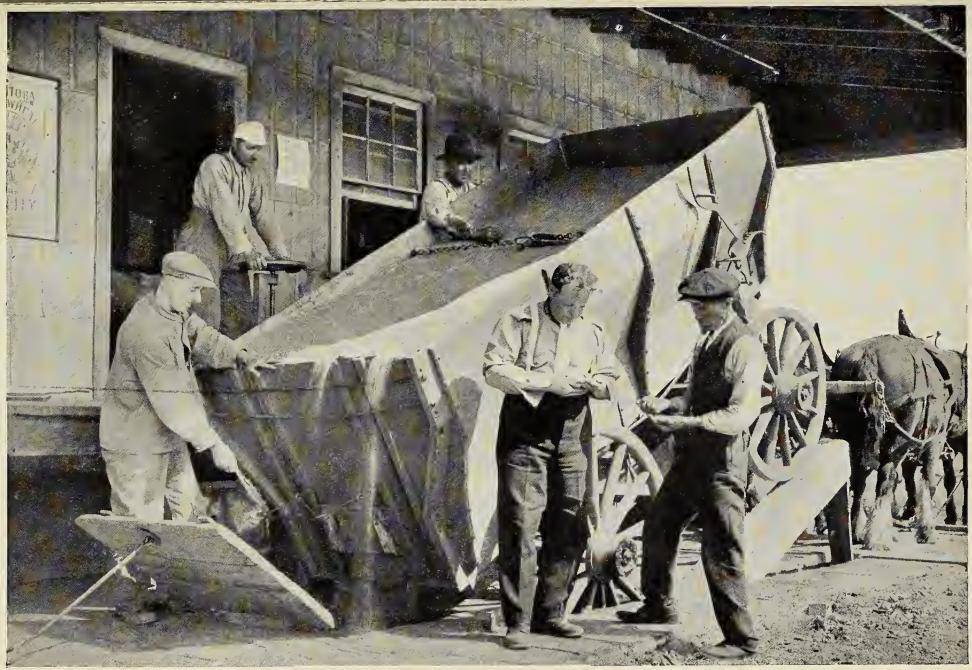
experiment a success, and when the few heads were ripe they were shipped to the head office in that little sack thrown so carelessly on the cupboard.

Old William Saunders had all work stopped until the missing packet was found, then he planted the seeds and awaited results. One of the new seeds might produce a Red Fife wheat and another might produce a Hard Calcutta. It was the patient work of Dr. Charles Saunders for years in picking the best strains from them and saving their best seeds that finally produced the Marquis, world winner in 1907, ripening in one hundred and ten days, when other grains froze, and producing a flour as heavy and white as the Red Fife. Because this wonderful wheat can be grown so far north, that Canada's wheatfields are doubled and she now leads the world in the export of golden grain, Dr. Charles Saunders is rightfully honoured as a great Canadian. But let us not forget Dr. William Saunders, who planned so carefully and laboured so faithfully that the great experiment might be a success!

Garnet Wheat—A new variety of wheat, called the Garnet, has been developed, which ripens from five to ten days earlier than even the Marquis. Its yield is heavy, but the colour is creamy-yellow rather than the famous creamy-white of the Marquis. Its use is destined, however, to push the northern boundary of the wheat limit still farther north and greatly enlarge the wheat production of Canada.

10. THE WHEAT BUSINESS

When Canada grows over four hundred million bushels of wheat, thirty-eight million bushels are saved for seed, sixty million bushels are milled, and over three hundred million bushels are exported, by far the largest consumer being Great Britain. Wheat travels to Europe by three main routes. One-half goes down the Great Lakes to Buffalo and through the Erie Canal to New York, less than one-quarter is shipped west to Vancouver and through the Panama Canal, while over one-



Department of the Interior

GRAIN WAGON AT ELEVATOR

quarter goes either by the Great Lakes or by rail from Fort William to Montreal and out by the St. Lawrence River.

As soon as threshing is begun, the huge wheat transportation system is organised, and the grain is rushed forward so that the bulk of the crop may be sent down the Great Lakes before navigation closes in November. All grain east must pass through the narrow funnel at Winnipeg, and 1173 cars of wheat in a single day have been hauled into that city by the Canadian Pacific Railway. At Fort William and Port Arthur huge grain-steamers take from the terminal elevators up to one hundred thousand bushels an hour, and are loaded in four hours. They are bound for Buffalo, if the grain is to go through the Erie Canal to New York, and, if their cargo is destined for Montreal, for Port Colborne on Lake Erie. Here the wheat is unloaded into smaller boats, which can pass through the Welland and Lachine Canals and meet the ocean-bound steamers at Montreal.

In specially constructed grain-boxes holding from sixty to one hundred bushels, the farmer hauls his grain in bulk to the elevators at the railroad towns. The wagon is driven to a platform scale inside the elevator and weighed. The grain is then dumped into a hopper below and raised by a gasolene engine to bins in the elevator, from which it later descends through a funnel into the waiting car. If the farmer sells his grain outright to the elevator company, it is known as street grain; but he may have it stored in a special bin to be sold later. A loading platform is provided at every station, where the farmer may order a car and load it from his wagons within a specified number of hours. Thus he may have it sold or stored in Winnipeg, if he is not satisfied with the price offered by the elevator company or with the grading that they assign his wheat.

Within the past few years a new form of co-operative marketing, known as the Wheat Pool, has been developed by the farmers. This organisation, begun in 1923, in 1926 handled 190,000,000 bushels of wheat. The method of working is to secure five-year contracts with the farmers for the marketing of all their wheat. A fixed sum per bushel is paid in instalments, and the final profits are shared after the expenses of marketing and elevators are deducted. Its members now number 71,818.

Box-cars used for carrying wheat are loaded in bulk and carry 1350 bushels. The wheat rolling east all passes through Winnipeg, and is there tested by Federal Government employees, under "The Canada Grain Act." This Act creates a Board of Grain Commissioners, whose duty is to fix grades, to settle the question of the grade to which each shipment belongs, to inspect elevators, to superintend loading into steamers, and to see that the grower has a fair disposal of his product. The western head-quarters for the Board is at Winnipeg, but inspections are also made at Calgary, Moose Jaw, Saskatoon, Fort William, Port Arthur and Vancouver.

As soon as a wheat train arrives at Winnipeg, a gang of men sets to work to secure samples from every car for the inspection-room. An official breaks the seal of the car door and the sampler with a "stabber" takes a few grains of wheat from different parts of the car. So rapidly do these men work that a train of forty-five cars is sampled in an hour. In the inspection-room the staff determine from the samples the weight of the wheat per bushel, the amount of weed seed contained, the moisture contents, plumpness, and other factors by which the grade is set.

A small amount of fall wheat is grown in southern Alberta, but the greater proportion of western wheat is known as spring wheat because it is planted in that season. Spring wheat is graded into No. 1 Hard, No. 1 Northern, No. 2 Northern and No. 3 Northern. No. 1 Hard must weigh not less than sixty pounds to the bushel and be composed of not less than 75 per cent of Hard Red Fife or Marquis. In No. 1 Northern the percentage of Hard Red Fife or Marquis may be reduced to sixty. No. 2 Northern must weigh fifty-eight pounds to the bushel and must contain 45 per cent of Hard Red Fife or Marquis, while wheat grading below these standards is known as No. 3 Northern, unless graded still lower as No. 4, No. 5 and No. 6 Northern.

As vast amounts of money are needed to handle the crop when it begins to move seaward, the banks provide extra cash to meet the emergency in each town. When a farmer's wheat is in the elevator or on a car he can draw nearly its full value

from the bank. Money is also advanced to the farmer during the harvest to meet current expenses.

Wheat is the most essential food of man, and when once it is matured and dried, the coldest weather does not affect it. It is probably the least perishable of all foods, and if not subjected to heat and moisture, which cause it to germinate, it will keep for centuries. In the quality and export trade of her wheat, Canada ranks first among the countries of the world; and this proud position will give her greater economic independence as the years go by.

11. FIELD CROPS

Oats.—Oats rank second to wheat in value as a grain crop, being used whole for feeding horses and hens, and being ground for oatmeal. The straw has a slight value for feeding stock, while wheat straw is worthless. Oats mature more quickly than wheat, and may be seeded after the wheat is up, on land that was too wet to seed earlier in the season. They still have time to mature, for they are not injured by early frosts.

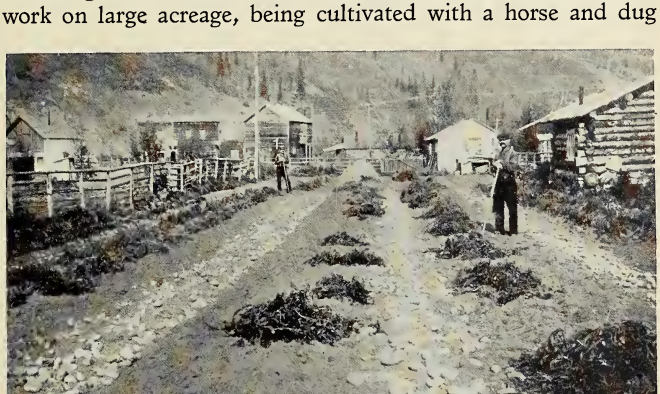
Alberta produces more oats than any other province, the yield sometimes reaching one hundred bushels to the acre. The growing of Banner seed-oats is an important industry in Prince Edward Island.

Timothy and Clover.—In Canada timothy and clover are the most important grasses that make up the hay crop, which provides winter feed for the stock of the farms. At first these valuable grasses would not root in the prairie soil; but, as more humus has been added through grain-growing, timothy and clover fields are appearing in Manitoba and Alberta and in northern Saskatchewan as well. Clover and grass seed, to the value of over three million dollars, is grown annually in Canada.

Potatoes.—The potato is our most important vegetable, and the only one of which people never tire. It contains both cell-building food substances and those which produce heat and energy. Eastern Canada has an extensive market for potatoes

in the West Indies, and Prince Edward Island has made a large beginning in the growing of certified seed-potatoes under Government supervision, the seed finding a ready market in the Southern States.

Potatoes are of a drier and finer quality when grown on light soil, and need little rain until after they are set. They can be well grown on commercial fertiliser and require little hand-work on large acreage, being cultivated with a horse and dug



Department of the Interior

POTATOES IN DAWSON

by machinery. The great enemy of the potato is the Colorado potato-beetle, which is a veritable pest, requiring constant spraying, and has travelled as far west as the Kootenay country of British Columbia. The crop is also sprayed for potato-blight.

Flax.—Flax is grown in northern countries like Canada for the fibre, from which linen is made. An impetus has been given the industry because of its practical discontinuance in Russia since the war. The crop is now worth about seven million dollars yearly, the finest plants being grown in Gaspé Peninsula. For the production of good fibre a very moist climate, with a long, moderately growing season, is needed,

and these conditions prevail in British Columbia, south-western Ontario, the valley of the St. Lawrence and the Maritime Provinces. The principal market for the Canadian fibre is in the United States, from which we import large quantities of flax products that could well be manufactured in Canada.

Tobacco.—Tobacco is grown in Quebec, Ontario, and recently the Okanagan Valley also. It is a sub-tropical plant which requires a warm climate, being injured by the slightest

Department of the Interior

TOBACCO FIELD AND DRYING-SHEDS

Notice the openings for the passage of air through the sheds.

frost. The varieties grown are early maturing with short leaves, the season extending only from the first week in June to the end of August. The industry is protected by a duty of 40 cents a pound on the imported leaf. Montreal is the principal centre for the manufacturing of the product, while a new market has been found in England for the purchase of the leaf.

Sugar Beets.—The first attempts to establish a beet-sugar industry in Canada were made in Quebec in 1890. The operations extended to Ontario, then to the Raymond district of southern Alberta, and in 1927 to the Fraser Valley of British Columbia.

In 1925 the industry produced 36,400 tons of refined beetroot sugar.

12. THE FRUIT INDUSTRY

THE human system craves fruit because it supplies the mineral substances necessary for the building of blood and bone. Luscious fruits are the crowning achievement of the vegetable world. They are the precious gifts that the plant or tree offers to the animal world, with the hope that the hidden seeds may strike root in a new domain. The fruits of temperate lands are of the finest flavour when they grow as far north as the climate will allow; so Canadian orchard fruit and berries are supreme in quality. The value of our fruit crop in 1926 was $25,000,000, the exports consisting largely of apples sent to England. At the same time Canada bought $18,000,000 worth of fruit, chiefly from the United States. Two-thirds of these imports were fruits that cannot be grown in Canada, such as oranges, lemons, bananas, etc. As American fruit is earlier than ours, we pay a high price in order to procure it ahead of our own season. A return trade is now being built up, when we ship such fruits as strawberries to the United States after theirs are off the market.

Apples form two-thirds of the total value of Canada's fruit crop. They are grown so extensively because of their good keeping qualities. After being picked, berries are fresh for only two or three days; plums, peaches and cherries for scarcely a week; but apples remain sound for an entire winter, and form our main fruit after the others, in early autumn, have disappeared from the market. A voyage across the ocean improves their flavour, and Canadian apples have a premium above all others in the English market. The Annapolis Valley, the Niagara Peninsula and the Okanagan Valley are the three famous apple districts of Canada, but in many other sections they can be grown with equal success. Fruit is never a certain crop like oats, hay or potatoes. A late spring frost, when the trees are in blossom, may ruin the prospects of a crop, while a dry summer will cause the fruit to drop, or high winds will shake it from the trees.

If apple seeds are placed in the ground, the seedlings that

spring up will not produce the same variety of apples as those from which the seeds were taken, but they will grow a worthless natural fruit. The proper variety, in the form of a scion, is grafted into the top of the seedling after it is cut off close to the root. Apple-trees are planted fifty feet apart, and bear fruit at seven years of age, and, by having their tops renewed by grafting, will produce a crop until they are well over sixty years old. An apple-tree yields a heavier crop every other year.

Department of Natural Resources, Nova Scotia

APPLE ORCHARD IN BLOSSOM

In the Annapolis Valley, which sells as high as four million dollars' worth of apples to England in a good season, the orchard is the main part of the farm, which may have forty acres with trees of different ages producing apples. The first work in the spring is to trim the trees of extra growth, leaving room for the apples to receive sufficient sunshine. Grafting to produce a better-sized apple or a different variety is also done in early spring. The trees are sprayed once before the leaves appear and twice after, to kill such insects as the codling-moth, the tent-caterpillar and the canker-worm. When the trees, during the first week in June, burst into bloom and fragrance, the whole valley for sixty miles is one white mass of blossoms.

The orchards are cultivated during the summer to preserve the moisture and to keep down the weeds, while commercial fertiliser is extensively used to obtain a crop. By the middle of September the famous Gravensteins are ready for market, and from then until the end of October the apple-pickers continue their work. Warehouses at the various stations receive the fruits packed in barrels of 125 pounds, or two and a half bushels, and forward them to commission firms in England.

Department of the Interior

PRIZE STRAWBERRIES
How many in a box?

When the crop is small, the owner of a warehouse may buy apples by the barrel from the farmer, have them packed, stored and shipped as the market warrants. A farmer usually prefers to sell at the moderate price of $2 a barrel rather than trust to the uncertainty of the market when his apples may reach the commission men, although returns have netted him as high as $5 a barrel. Canada does not over-stock the British market, for England buys only 19 per cent of her apples from our country and 38 per cent from the United States. Apple-packing in the East is done in forty-pound boxes as well as barrels, a method which has always been in use in British Columbia, as it is more convenient for the Canadian consumer.

Grapes, largely raised in the Niagara Peninsula, are

approaching the two-million-dollar mark and rank second in value for Canadian fruit, while strawberries are a million and a half in value and come third. The strawberry root-weevil is a very serious pest, and the necessary hoeing is a drawback to large acreage, but in spite of such handicaps farmers often net $1000 an acre for the strawberry crop.

British Columbia and Ontario both compete for the fruit market on the prairie, and better organisation is helping to displace the large amount of American fruit that enters our Middle West. The biggest problem for the fruit-grower is the marketing of his crop during the short season of a few weeks. The small fruits picked to-day must be on their way to the consumer to-morrow. Co-operative marketing, in which a central organisation keeps the stock rolling and equalises distribution, so that each market receives only as much as it can handle, seems to be the solution of the problem in the future. The fruit-growers in British Columbia and Nova Scotia are fairly satisfied, from the results already achieved, that in such a union there is strength and equity.

13. CATTLE RANCHING

We live in a changing world, and so many new methods are being used in almost every industry that, unless we revise our knowledge constantly, we are as far behind as Rip Van Winkle, who slept for twenty years. Many people think of ranching in terms of motion-picture plays, in which they see the bow-legged cowboy begin his day with a few setting-up exercises on the back of a bucking bronco. Next he springs on his favourite pony, which seems to have been saddled all night, and rides over several mountains to the spot where a Mexican cattle-thief is hidden. Even with a revolver in each hand and two in his belt, it is with the greatest difficulty that he makes the robber a prisoner, just before he himself is captured by the sheriff through some terrible mistake.

The Canadian cattle-rancher leads no such thrilling life.

He has had to change so often his methods of marketing and feeding, that only his love for cattle remains constant in his varying life. The rancher would still raise stock even though he were certain of a loss in his business, for the animals are to him as children; he knows their every mood, feels that they know his spoken word, recognises a calf that has wholly changed since he saw it last, and goes among his herd as a city man among his friends. No one is enjoying life unless he finds such pleasure in his work.

Cattle have always been a symbol of wealth,[1] for they are the most useful of all domestic animals. Beef, butter, cheese and milk for food, hides for leather, even tallow for candles, have been provided by cattle; and the patient and strong ox, as a beast of burden, has served man faithfully and well. Throughout Canada, where mixed farming is constant, cattle have kept the land enriched for the growing of crops, for costly fertilisers have made poor the farmers and the soil.

The biggest problem in cattle-raising in Canada is to feed the stock through the long, cold winter. In Eastern Canada the cattle must be kept in a stable from the first of November until the middle of April. During this time a cow eats three tons of hay, besides roots and grain. Her board bill during that time is at least $40 without extras. To feed three times a day, water twice and clean the stables for thirty head of mixed stock keeps one man so busy during the winter that the lighted lantern is often seen in the barn. Then there are the exciting times when a cow works loose and forages in the oat-bin, or chokes on a potato; or two animals become wedged in a doorway; or a cow places her foot in a pail of milk and refuses to move; or when a swaggering steer is thrust through the fence by the sharp horns of an old cow, who, in a burst of temper, has decided to endure his insults no longer.

Before the land was taken up for wheat farms, the great open ranges of Alberta, from the boundary to the Peace River, were the feeding-grounds of big herds of cattle on open ranches. The prairie grass dries out in the fall and serves in winter as

[1] *Pecuniary*, meaning relating to money, traces its descent from the Latin word *pecus*, meaning cattle.

hay for stock, but while broncos can paw the snow and live on the grass beneath, a severe winter with heavy snowfall was most disastrous for cattle. Now that the level lands in Alberta are marked off into wheatfields with wire fences by the farmers, the days of open range are largely over, and the cattle ranchers herd their stock on their own lands in the foothills of Alberta, or in the Upper Fraser district of British Columbia. Now each rancher is also a farmer in that he grows and puts up a ton of hay for each head of stock. In British Columbia and southern Alberta, alfalfa is being grown where there is water for irrigation; and since it produces three crops a year, each a much heavier yield than hay, its extension is being followed with great interest.

The best beef is from steers which are full grown when three years old, and one well fed should then weigh from twelve to fourteen hundred pounds. The two best and most common breeds are the Shorthorns or Grey Durhams and the Herefords, easily known by their white faces and sturdy forms. When beef sells at 6 cents a pound on foot, a good steer is worth $80 as the beef in an animal is exactly one half of the live weight. The great problem for the rancher in Canada is to find a profitable market for his beef. England uses large quantities of beef, but has always insisted that the Canadian cattle should be shipped alive to their country. It is a long haul by train from the Rockies to the Atlantic, and a great shrinkage results from crossing the ocean in a freighter, for cattle can be just as seasick as people. For many years, fearing the spread of disease, England placed an embargo on Canadian cattle, which meant that after 1896 our store cattle were not allowed in English ports. While the embargo was raised in 1923, the ranching industry has not yet recovered from those lean years. Beef in the United States is now worth 11 cents on foot, but their duty of 2 cents a pound on Canadian cattle works heavily against us in that market. Yet in spite of the duty Canada sells large quantities of beef to the States.

Each rancher has his brand, and in midsummer, when the calves are about three months old, a round-up takes place. The cattle are herded into a corral and the calves are roped,

thrown and burned to the skin with a red-hot iron. When the bellowing calf is released, he carries for the rest of his days the owner's brand. A maverick is a steer that has missed being branded, and so has no lawful owner.

Ontario has been a pioneer province in developing pure-bred cattle, which are registered in a book with the Dominion Government. The splendid large breeds of to-day are due to careful selection over many years, prize animals having sold

Department of the Interior

CATTLE IN STOCK-YARDS

Notice the cars on the track in the background. Cattle are gathered in the stock-yards before being shipped. Notice also the hay-racks, the gates and the runways.

as high as $15,000 for breeding purposes. But although we have improved their size and milk-production, the habits of cattle are much as they were thousands of years ago. They still like best to feed in the early morning, just as though they expect a lion or tiger to be searching for a meal at eventide. By rising first on their hind-feet, they feel more secure in bringing their heads into view last.

Better trade relations with those countries furnishing us a market for beef, pure-bred stock, the development of the growth of alfalfa for winter fodder, and the opening of the Peace River country, will make cattle-ranching in Canada more important as the years go by.

14. DAIRYING

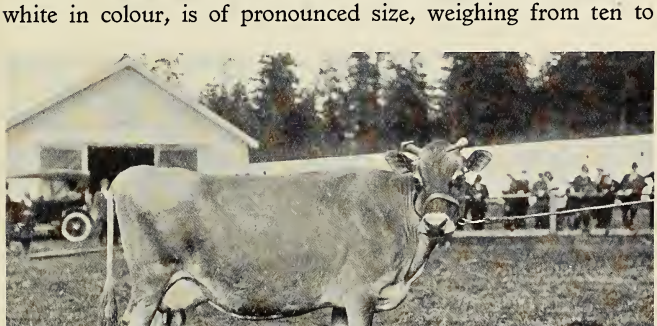
We could scarcely serve a meal without the assistance of the cow. What a scanty breakfast it would be without milk for the cereal, butter for the toast, or cream for the coffee! Should the bottle of milk become sour, the city family has difficulty in securing a substitute until the next visit of the milkman. Milk is a necessity for growing children, yet those who do not live on the farm scarcely ever receive an adequate supply. The people of northern climes crave butter-fat as a heat and energy producer, so that good bread and butter, with milk, supply the main materials needed for the upkeep of the body. A generous slice of butter goes into almost every dish that is cooked, and cheese is a very valuable food. Ice-cream is becoming a popular dessert, while with children the ice-cream cone is in greater demand in the summer than candy.

With the farmer the cow is the basis of mixed farming. If he sells the cream alone, or churns his own butter, the milk, and the buttermilk left from the churning, are necessary for raising chickens and swine; while, for the first three months of their lives, calves live wholly on milk. If the farmer sells his hay, his land soon becomes impoverished, unless it is natural dike-land, but if he feeds his hay, oats and root-crop to cows, he not only has a return in the milk, but the manure makes a necessary fertiliser which restores the soil and makes it capable of producing a high return to the acre in fruits. Often a part of the farm is too rough to plough, but, when fenced, such waste land yields a return as pasturage for cows in summer. The farmer who keeps cows as his main stock saves the heifer calves for his future herd and forces the steer calves on whole milk until they are a month old, when they are sold for veal at a fair profit.

The milking life of a cow is from three to twelve years, while she is most valuable as a milker from the fourth to the eighth year. A cow usually raises a calf each year, and gives the greatest quantity of milk after the birth of her young. Before that period her milk dries off, and as it lessens she may be milked

only once instead of twice daily. A low-grade cow might be dry as long as three months, while a more profitable and higher-grade cow would be dry for only a few weeks. A cow's age is readily told by the rings on her horns, the first one appearing when she is three years old, with one each additional year.

The two most popular breeds of dairy cattle in Canada are the Holstein and the Jersey. The Holstein cow, black and white in colour, is of pronounced size, weighing from ten to



Department of the Interior

THE PRIZE JERSEY

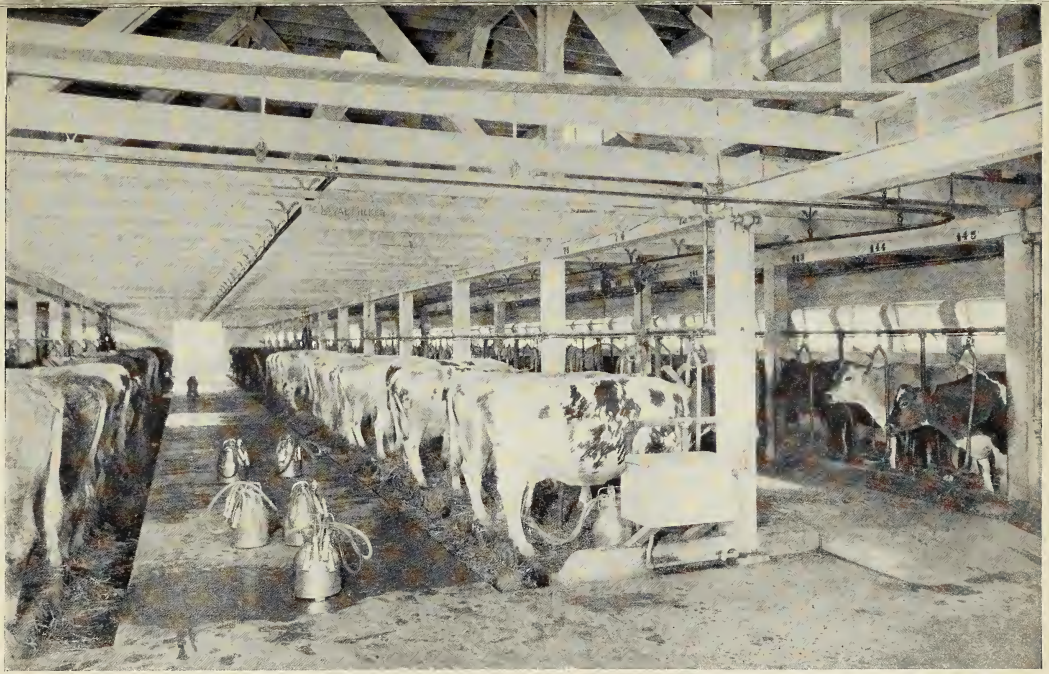
sixteen hundred pounds, and produces a large amount of milk, the better ones being expected to give about five gallons a day. This cow also yields a good return for beef when her milking days are over. The Jersey is yellow, shading to black, in colour, is of smaller size, requires a warmer climate, and produces richer milk, but less in quantity, than the Holstein. The Jersey calf, closely resembling a deer, is always a pet with the children.

In Canada there is one cow to every two people. The value of the dairy products is over $240,000,000 yearly, and three-quarters of this great quantity is consumed within the country, each person averaging $10 for milk, $10 for butter, and $2 for cheese. Since nearly half the people in Canada live in

towns and cities, the farmers sell half of their milk fresh each day to the dairies at about 20 cents a gallon. The pasteurisation, the bottling, and the delivery of the milk at the door in wagons, add another 20 cents to the price, so the consumer pays in the neighbourhood of 10 cents a quart for his bottle of milk. The farmer who lives close enough to the city to be able to take advantage of this market makes the most profit from his cows, so these men make dairying their main industry, often buying a large share of the feed needed to produce the milk. Many large cities, like Montreal and Vancouver, are situated in or near river valleys, whose level and fertile lands, yielding rich fodder and pasturage, are ideal for dairying. The farmers too distant for milk shipments to cities keep a few cows to sustain their mixed farming, and either sell their cream or milk to the creameries, where butter is made, or else make their own butter at home.

This profitable industry has its disadvantages and hardships. Milking by hand is a trying task, and good milkers are hard to secure. Jerseys are over-sensitive, have small teats, and are quick to resent with their feet any suspected injury, while real strength in the wrist is needed to draw the milk from a Holstein. Cows must be milked at the same time twice each day, and as the milk is usually shipped early in the morning, and the cow likes to feed when the day is young, the milker rises with the alarm-clock. A change of milkers is fatal to the supply of milk, and the dairy business does not thrive on an eight-hour system, and must also be prosecuted seven days in a week. A man who milks on an average ten cows an hour finds ready employment with any dairyman. Careful Government supervision has kept diseases in check, but while Canada has been free from the fatal foot-and-mouth infection, tuberculosis takes its toll when the herds are tested by official inspection. Flies in summer, by plaguing the cows, lessen the yield of milk.

Great advancements have been made in the dairy industry. In the old days farmers set the milk in earthen pans on the cool cellar ground, and skimmed the cream from the top. Later this separation was effected by a creamer, which was a tall can with a faucet at the bottom for drawing off the milk.



Hughes Brothers

C.M.S. CO. COW BARN (INTERIOR)

Find six points that show this barn to be up-to-date.

It was hung in the well, and a calamity resulted if the rope broke or the faucet was not tight. The result of the churning was never a certainty, as the cream might be too sweet or too sour, and in winter, at times, after hours of patient churning, might not break into butter. In winter the butter, carefully salted and coloured with carrots, would bring a fair return in trade at the country store, but in summer many a hard-working farmer's wife had her pride wounded by the remarks of the storekeeper when he saw her arrive on a hot day with twenty pounds of soft butter. But usually the country merchant had the tact of a diplomat, and instead of lowering the price of the butter, he raised the price of the goods to cover the loss which was sure to follow when he shipped the butter to the city.

The cream separator, invented in Denmark, was introduced into Canada in 1882, and twenty years later became general throughout the country. When the handle is turned, the milk, passing through a rapidly revolving bowl, is separated from the cream, which, being lighter, is thrown farther out, to collect in a separate passage. Creameries soon became widespread, and produced a quality of butter and cheese uniform with, or superior to, that made on the farm. Creamery butter, packed in summer in ice, sold for a regular and fixed price, so that barter in this article at the country store ceased, to the great satisfaction of the farmer's wife and the merchant. Co-operative creameries, in which the farmers own shares, have been the next development. They are well organised and generally satisfactory in Alberta and Ontario.

Regular herds of pure-bred dairy cows, registered with the Government at Ottawa, have largely supplanted the mongrel stock of earlier days. In this important work of breed improvement Ontario has led the whole of America for both dairy and beef types.

Large, clean, and well-lighted and ventilated barns have taken the place of the old stables with wooden slides for windows. Instead of being fastened by immovable wooden stanchions and crowded closely together, cows are now tied by chains or secured in revolving stanchions with plenty of side-room, and running water is within reach. Where electricity is available

for motor-power, milking-machines are now employed in very large dairies, and probably the future will see their use extended.

When a cow produces more milk, she requires a greater amount of feed. As dry hay in winter yields little milk, the farmer formerly depended on the fresh grass in summer for his big return. The silo has enabled the dairyman to supply his cows with green feed in the winter. Clover, alfalfa, peas, sunflowers and corn are cut green, chopped fine, and placed in the huge, cylindrical, air-tight silo. The heat from the fermentation of the green ensilage cooks the fodder, which is relished by the cows in the winter months. Unfortunately corn, best of all ensilage foods, is only well adapted in Canada to southern Ontario. It has been lately discovered that sunflowers grow well in the prairie provinces, and this advantage will be of the greatest assistance to the dairymen in that part of Canada. Turnips, mangel-beets and white carrots are pulped and supplied to cows with a ration of ground oats and cotton-seed meal.

One quarter of the dairy products of our country is exported to Britain and the United States. Canadian butter and cheese are at a premium in England, large quantities being supplied by Ontario and Quebec. Modern methods of cold-storage and ocean refrigeration make it possible for butter to arrive at such a distant market in good condition. Ontario and Quebec are shipping an ever-increasing quantity of fresh milk to New York, Boston, and other large American cities on the Atlantic coast. Condensed milk and milk powder are made in large quantities, and are finding a market in hot countries like Asia. The St. Lawrence River Valley is one of the greatest dairy areas in the world, while southern Ontario has helped to put the industry on its present sound basis. Manitoba and Alberta are increasing their dairy herds, while British Columbia has many fine valleys beside the Fraser Valley, where the industry could be well established.

Hughes Brothers

C.M.S. CO. COW BARN (EXTERIOR)

15. THE HORSE

The horse has performed a very important work in the industrial development of the country. He has ploughed and harrowed the fields, cultivated the crops, and drawn the produce to market; carried the earlier settlers on his back, helped to clear the land and build roads, on which he drew the people in carriages. For a long time he transported the goods of cities along paved streets; and now, with the expansion of the motor industry, which has replaced the horse in almost all city work except delivery from door to door, when many predict that the work of the horse is over, we find more of these faithful animals in use throughout the country than ever before. Although the tractor may be successfully used in large farming operations on level land, the machinery is so expensive that the average farmer will, for years to come, depend upon the horse for the cultivation of his soil.

The light driving horse has disappeared as the automobile has taken his place. Heavier types of work-horses are being used on the farms at present, the improved Clydesdale, weighing around sixteen hundred pounds, being the most popular. When so much new western farm-land was being opened up during the first ten years of the present century, Ontario, the home of thoroughbred stock, could hardly supply the demand for horses, and prices ranged as high as $300 each. But now, with the rearing of horses on the prairie, the price has dropped to less than half.

Horses eat grass more closely than cattle, and can live on the western ranges in winter by pawing away the snow to find the dried grass beneath. They thrive best on timothy and clover hay and oats.

16. SUFFOLK SHEEP

James Brock has a ninety-acre farm in the St. John Valley, forty acres being excellent meadow-land, which yields two tons of hay per acre yearly without fertiliser. His remaining acreage is upland, hilly and partly covered with forest; so this part of his farm is used as a pasture. Mr. Brock estimates that each cow, through the winter, requires three tons of hay, and that five sheep eat as much as a cow. As he can milk ten cows, he keeps only that number, selling the hay that he does not use as feed for $10 a ton.

Last year Mr. Brock decided to try an experiment with sheep, thinking that he could manage thirty along with his cows. He undertook to purchase his flock early in March, and found that his neighbour would sell thirty Leicester sheep for $250. They were two years old, heavily fleeced and pure white, but because of the low price of wool and the high price of spring lamb for the butcher, he decided to buy the dark-faced Suffolks instead, as they were more suitable for the latter purpose. At an auction he bid in forty at $9 each, less 10 per cent discount for cash, and, while driving them home, sold ten for $100, taking a note in payment for one year at 8 per cent.

The spring was late; so, as he had sold his extra hay the previous autumn, he had to buy thirty hundredweight of hay to feed the sheep until they could go to pasture. He also paid $36 for a ton of oats to feed the sheep during the lambing season. In April ten sheep gave birth to twin lambs and eighteen others raised one lamb each. Three sheep would not own their lambs; so Arthur Brock, who hopes to be a farmer some day, raised two of these by feeding them cows' milk from a bottle. Eighteen of the lambs that lived were females, or ewes, so these were kept to enlarge the flock, and this spring were valued at $10 each. The sheep went to pasture early, but did not stay there, as the fence had been built only to enclose cows, so these smaller animals crawled under the fence and spread out over the meadow, where there was better feed. As sheep gnaw grass down to the very roots, they do not belong in a hayfield in

spring, so Mr. Brock hurried to town and bought 320 rods of wire at 20 cents for 100 feet. This was smooth wire, less expensive and better than barbed wire, which tears the wool; and a lower strand was added to the pasture fence.

In the warm days at the end of May, the sheep were brought from the pasture to be washed. Sheep have a mortal fear of water, are never seen to take a drink, and thrive best in a cold, dry climate; because, when their fleeces are soaked in a rain-storm, the additional weight is hard to support. The sheep were washed in the watering-trough under the pump, in spite of their struggling and protest, and a week later were brought back and sheared. For this trying task Mr. Brock hired a man who did the lot at 35 cents each, spending three days of ten hours each at the task. A shearer keeps his knee on the sheep's neck and holds two legs in one hand, while he clips with the other. When the sheep is partly sheared she struggles to free herself and, if she escapes, a trail of wool follows in her wake. The sheep together sheared 290 pounds of wool, which sold at $9\frac{1}{2}$ cents a pound. After shearing, the sheep were dipped in a strong solution to kill the ticks which infested them, and the lambs were immersed in the same bath.

In the middle of August the male lambs were ready for market and averaged sixty-two pounds each, live weight, selling for 14 cents a pound.

In October one misfortune happened to the flock, when a savage dog in the district turned sheep-killer and destroyed three of the best sheep before he was shot.

The flock wintered in a shed and were given hay once daily in a rack outside. They fed in the meadow until snow came, and always stayed out unless the weather was stormy. In November Mr. Brock bought for $25 a Suffolk ram, imported from England. A year from the time that he made his purchase he figured that his investment had made him a very fair profit.

PROBLEMS ON SHEEP

Arithmetical Problems based on Reading Ability

1. In what province does Mr. Brock live?
2. How many tons of hay did he usually sell after feeding his cows?

3. How many tons of hay would thirty sheep consume during the winter?

4. How much less did the Suffolk sheep cost him than the price asked for the Leicesters?

5. With the interest added, how much did he finally realise for the ten sheep that he sold?

6. How much did he pay for extra feed for the sheep during the first spring?

7. How many lambs were born?

8. How many male lambs were there to sell?

9. How many sheep did he have in March of the next year?

10. Why did Mr. Brock figure his profit in March instead of the previous November?

11. How many pounds of wool did each sheep average?

12. What was the total price of the wool?

13. What was the total value of the flock, when the year's profit was figured?

14. In estimating the profit, what two sums of money should be kept separate from the sheep account?

15. What was the cost of the wire for the extra fencing?

16. What was the total amount spent on the sheep during the year?

17. What was the total amount received?

18. What was the total profit?

17. THE LITTLE WHITE HEN

EGG-PRODUCTION in Canada has developed into a scientific industry during the past twenty years. Before that time hens were generally regarded by the farmer as a necessary evil. When he reached into the oat-barrel, a hen would fly out; before he had time to make a fence around the garden, a hen with chickens would scratch up most of his seeds; and, when he hitched his team to the wagon in the yard, there would probably be a broody hen tethered to each wheel. The "Chick! Chick!" call for feed time found hens running and flying from every direction, while their combined assemblage presented a variegated scheme of colours: white, black, barred and red, mixed

and blended in varying proportions, each bird being a product of several different breeds. It was generally a delightful task for the small boy to search for a nest of eggs over deep haymows and under dark floors, and when a nest of a dozen or more was discovered, the eggs were tested for freshness by being shaken beside the ear. It is doubtful whether even an Indian scout could trail a hen to her hidden nest, which she approaches only when unobserved, and then in an indirect way. She is planning ahead for a big surprise, which she stages when, clucking and scratching, she leads a dozen young chicks into the farmyard. But give a brooding hen a setting of thirteen eggs, and beg of her to sit on them for twenty-one days until they are hatched, the probability is that she will break some, throw others out, and decide in a week that she would rather lay, leaving the nest cold.

Department of the Interior
HEN 6, U.B.C.

The use of the incubator has made possible the production of young chicks on a large scale, and hatching and selling day-old chicks has become a business in itself. For the first two days chickens do not eat, so they can be packed in cartons and shipped a considerable distance. A brooder with artificial heat takes the place of the mother hen until the chicks are six weeks old. Much valuable information is furnished by the Poultry Branch of the Agriculture Department on the care and feeding of hens.

Records of production are made by the system of trap-nesting, in which the hen enters a box to lay and in leaving must be released. From the number on her leg-band, her place is found on a record-sheet, where the egg is placed to her

credit. When a hen lays more than 225 eggs a year her stock is worth securing and she becomes a R.O.P. hen. In 1927 a white Leghorn hen, No. 6 of the University of British Columbia, laid 351 eggs in 365 days, and made a world record.

Since eggs are highest in price during the winter months, early pullets are eagerly sought, that they may begin to lay in September, and with care they may lay through until the next June. The main laying breeds are the White Leghorns, Wyandottes, Rhode Island Reds and Plymouth Rocks. It is doubtful whether there is any better layer than the White Leghorn, which, though small in size, lays a fair-sized egg, and has little inclination for brooding. This breed is of little use for table purposes, because of its light weight, the cockerels being usually shut into small pens when two months old and fattened to weigh a pound, when they are sold as broilers.

A greater yield per hen is produced from a small flock with sufficient green food, rich in nitrogen. The most profit is made when the farmer raises his own grain for the flock. The warm winter of the Pacific Coast is ideal for hens, but the poultrymen there, who keep thousands of birds on a few acres and buy all their feed milled, have to gauge their business very carefully. The industry of egg-raising is very extensive in Ontario; Saskatchewan has now gained a name as an egg-producer, because it has the necessary grain, and Vancouver Island and the Fraser Valley are large producers, because of their mild winter.

18. DOMESTIC DUCKS

A NOTED observer first drew my attention to the fact that a duck has far more intelligence than a hen. One of his ducks laid a nest of eggs in the corner of the hen-house, which stood far above the ground. She then decided to hatch the eggs; but it did not seem to the owner a likely place for hatching ducks, for their nest is usually made on the moist ground; so he moved it to a suitable spot on the ground under the hen-house. But the duck did not stay on the eggs five minutes. She spent a

day moving them back to the corner in the hen-house. If I were your teacher, I should like to ask you to try to explain how the duck moved her ten eggs back. The only road for the duck into the hen-house was up a steep plank, yet that determined fowl rolled the eggs, one at a time, with her bill, over the uneven ground, up the plank, and into the hen-house. She spent a trying day, but never broke an egg. Probably the hens hoped that she would be arrested for obstructing traffic, and the rooster thought that she was paying an election bet. You will be interested to know that she hatched out one duckling, who probably became a very determined drake.

Duck-eggs are usually hatched in an incubator, one of fair size holding two hundred eggs. The heat is kept steady at 103 degrees, slightly more than blood heat. The eggs hatch in twenty-eight days, probably requiring a week more than hen's eggs because they are larger. The eggs are turned in the trays twice a day and cooled for a few minutes at evening, for a reason that you would scarcely guess. At night the mother duck would leave her eggs and go for a short swim. The eggs are cooled a little longer each night. What does this tell you about the habits of the duck? Since the duck's feathers would be wet when she returned, it is necessary to moisten the eggs as they near hatching.

The skin of the duck-egg is very tough, so how does the little duck, with his round, rubber-like bill, manage to peck his way through? Nature provides the duckling with a little needle fastened to the upper side of his bill that he may work his way out into the wonderful world. In a day, the needle, so tiny that one would scarcely notice it, drops off. The ducklings on the second day, being quite dry, are removed to the brooder, where heat is furnished to keep them warm during the nights. Ducks a few days old are as soft and pretty as downy chicks. Their black, bright eyes, yellow fluff and web-feet add to their charm.

These birds have no diseases, but eat enormously and grow rapidly. In fact they are fully grown and ready for market in eight weeks. We must go back to the wild duck to find a reason for this quick growth. Hatched in the short summer of the

far Northland, the wild brood must develop rapidly in order to fly south in the early autumn. Young ducks are very active and will jump twice their height to catch a fly. A bow-legged duck, however, is helpless, as in walking he places one webbed foot on the other.

The White Pekin ducks are usually grown about Vancouver, the best customers being Chinese, who are especially fond of the roasted fowl and pay large prices to acquire their favourite dish in winter. In summer five-pound ducks sell for a dollar each, but our people have seemingly not acquired a taste for them.

Ducks are faithful watch-dogs, and are greatly excited when a strange person or animal appears. They sleep largely in the daytime and travel about quacking at night. Do these ducks that we rear have a longing to wing their way to the distant lands of the sunny South? Do they feel that great expanding waters far beyond their wire-enclosed prison call them to a life of freedom, where they may swim and dive and cradle in the breakers? Or are they like city people, content to dwell within walls of wood and stone?

19. SCIENTIFIC AGRICULTURE

Experimental Farms.

What are the best rations for feeding a milch-cow?

How can wire-worms be killed when they infest the soil?

What is the best fertiliser for growing apples?

What kinds of raspberries are best suited to a clay soil?

What is the life-history of the cabbage-butterfly?

What is the best crop rotation for growing hay, potatoes and oats?

What shade-trees serve best for wind-breaks on the prairie?

What is the proper feed for a horse when he has the heaves?

All of these questions and a hundred others are of intense interest to farmers, but it would need a lifetime of experimenting to be really certain of the correct answer to even a few of them.

So Government Experimental Farms have been established over Canada, where tests are made in a scientific way concerning the care and feeding of animals and the raising of crops on plots of ground, carefully measured and prepared in different ways, with the results carefully tabulated.

Those in charge of these farms also study the local conditions in their section of the country, and decide upon the most suitable crops for the district and the best methods for growing them; they study insect pests and their eradication; and they produce new varieties and better strains of seed, as Marquis and Garnet wheat and Banner oats.

It has been the policy of the Government to establish these farms in districts where the local climatic or soil conditions give rise to special agricultural problems. An Experimental Farm in southern Alberta would have to solve problems that would not arise in the coast district of British Columbia, as dry-farming, irrigation in relation to mixed-farming, and the growing of plants that would not be winter-killed.

Agricultural Colleges.—Agricultural courses are now being given by the leading universities, but Guelph Agricultural College is the pioneer and foremost school where young men are trained to become agricultural experts. Most of the Government fruit, seed, poultry and animal inspectors have graduated from this institution, as well as veterinary doctors, managers of creameries and the experts of the Experimental Farms.

20. IRRIGATION SYSTEMS

In Canada the areas that require irrigation are confined to the southern part of Alberta, the south-western part of Saskatchewan, and the Dry Belt of British Columbia. In all other parts of the country Nature has provided ample rainfall for the needs of agriculture. The areas which an irrigation system is intended to serve may be very extensive or comparatively limited. In Alberta some very large tracts of land are served by single systems of irrigation. The most famous, perhaps, is that

installed by the Canadian Pacific Railway in the district east of Calgary, which has reclaimed an arid region of 650,000 acres at a total cost of $15,000,000. Over four thousand miles of artificial ditches are used in this system. The same company operates another system, serving an area of eighty-two thousand acres, near Lethbridge, and has installed a third which irrigates seventeen thousand acres near Taber. Two other companies have put in irrigation systems in southern Alberta capable of watering over three hundred thousand acres. In British Columbia, particularly in southern Okanagan, there are some fairly extensive systems; but many small projects have been carried out to supply water to semi-arid regions of limited extent.

In an extensive irrigation system, a dam of large size is usually required, either to control the water of a river or for storage purposes. A gravity system, with open canals, is usually employed to convey the water to the highest point of the land to be irrigated. In designing such a canal it is necessary to know the amount of water available for irrigation, the extent of irrigable land, the nature of the soil, and the kind of farming that is to be carried on in the district. Losses through seepage and evaporation must be allowed for. The fall or slope of the canal is also a determining factor as regards its size and structure. If a steep grade must be adopted, the bottom and sides of the canal must be prepared to resist erosion. If the fall is very slight, silting may take place.

The intake of the canal is usually made of concrete. It is provided with gates for controlling the amount of water required in the canal. Besides the main canal there will be, no doubt, several branch canals, as well as subsidiary and distributary outlets for the water. The main canal sometimes leads to a storage reservoir, which may be a natural lake or one that has been artificially formed. The number of acre feet of water in such a reservoir must be accurately calculated. An acre foot is the amount of water required to cover an acre to the depth of one foot.

If a storage reservoir or balancing pool is not feasible, spillways will have to be provided for taking care of exceptionally heavy rains. A rise of two inches in the main canal may

result in a rise of a foot or more in subsidiary canals many miles below. The main canal divides into a series of secondary canals of smaller capacity. These are again split up into still smaller distributary canals of various size, according to the acreage they are intended to serve. As might be supposed, the water is delivered to the highest point of each farm. Gates are provided on all canals and their laterals, to shut off or turn on the water as required.

The aim of the engineer who designs an irrigation system

Department of the Interior

ORCHARD UNDER IRRIGATION

is to supply to each farm the quantity of water it requires for successful cultivation. Delivery of water may be made by keeping up a flow constantly, in rotation, or on demand. As a rule the continuous-flow method of delivery is wasteful and impracticable. When possible the water should be delivered on demand; but in cases of limited supply, the rotation method of delivery is the most equitable and satisfactory.

In the smaller systems, such as are employed in the Dry Belt of British Columbia—the Nicola Valley, Okanagan, Kamloops and the Kootenay, farmers sometimes co-operate to build a dam and main ditch, and then each man installs his own laterals, ditches or flumes. Where the utmost conservation of

the water-supply is imperative, flumes of wood or cement, instead of open ditches, are employed. Their use is to be recommended for other reasons than economy and permanency; they permit of more complete control of the water during the operation of irrigating.

These flumes that distribute the water to an orchard or field are placed about twenty-five rods apart, and range in size from six to ten inches. From the flumes the water is delivered through holes one inch in diameter, spaced three feet apart. Over each hole is a slide for regulating the flow.

For the greatest efficiency the fall of the flumes should be about one inch in twenty-five feet. The water is discharged from the flumes into furrows from four to six inches deep, ploughed through the field or orchard to be irrigated. These furrows, which should follow the contour of the ground, are run six feet, or farther, apart, and in clay soil may have the same gradient as the flumes, but in sandy soil this should be doubled.

Before land is irrigated it should be properly cleared, graded, ploughed and cultivated. It is impossible to irrigate land that is in hills and hollows. When this work has been done, the land should be well irrigated in preparation for planting. A depth of four to six inches of water will be required. Even when a young orchard is to be set out, the land should be put into a good state of tilth before the trees are planted.

In a semi-arid district one application of water during the summer may be found sufficient. In a season when the spring rains have been light, the first flooding should be given early in May. Additional floodings may be required at five-week intervals throughout the summer. It is very important that after each irrigation the land should be well cultivated, not once, but every ten days, until the water is again turned on.

21. ECONOMIC INSECTS

THE subject of entomology may seem unrelated to industry: but as a matter of fact, though not generally recognised, two of the important basic industries of Canada, agriculture and lumbering, depend for their very existence upon our ability to control the numerous insect pests that attack our forests, our field-crops and orchards. That man has to spend millions of dollars and ceaseless effort every year to defend himself against these tiny but formidable enemies is due to his own interference with the delicate balance of Nature. Since man undertook the task of controlling the forces of Nature and subduing them to his will, he has been continually confronted with the solution of intricate problems that tax the full power of his brain and his purse. As an instance of the importance that is attached to the depredations of one species of insect, the European corn-borer, of recent introduction, the United States Government, in co-operation with the State Legislatures, is spending millions of dollars annually in an effort to keep this pest from spreading westward into the corn-belt. The annual toll that insects take of the resources of this continent amounts to several billion dollars. This fact in itself should convince the most sceptical that insects and industries are intimately related.

In order that the Government may approach the problem of insect control intelligently, economically and effectively, it requires a small army of trained workers, who, in field and laboratory, study the life-histories of insects, both beneficial and harmful, and experiment on the methods of control that can be applied practically by agriculturists and foresters. The Government also employs a staff of specially trained inspectors, whose duties are: to examine importations of nursery stock and other products from foreign countries, in order to prevent the introduction of pests from other lands; to destroy or fumigate infected imports; and to investigate any reports of insect depredations within the districts under their charge. Occasional demonstrations are given in field or orchard to show the

farmers in an infested area how to cope with their insect enemies. They are advised as to the kinds of sprays to use and instructed in the method of applying them.

It has been proved that natural methods of control can often be adopted, such as the introduction of an insect parasite that preys upon the injurious species. This has been done in many cases and with gratifying results, especially as regards forest pests, which are hard to control by artificial means.

In spite of all efforts on the part of Government officials, insects continue to take their annual toll of farm and forest products. That this toll would be vastly increased if precautionary and control measures were discontinued or relaxed, there can be no doubt. But much better results would be obtained if the people of Canada, especially our rural population, had a clearer conception of their own personal responsibility in the matter of insect control. Lack of understanding, appreciation and co-operation on the part of men engaged in farming, lumbering and allied occupations, is accountable for the ineffectiveness of present methods of control.

Our agricultural colleges, universities and experimental farms are all doing a useful work in emphasising the importance of applied entomology: but as yet they have not been able to reach the ear, or at any rate the understanding, of the average farmer and lumberman.

Clean tillage, the keeping down of weeds, and the destruction of rubbish, have much to do with insect control in fields and orchards. Clean logging, the burning of slash, and the prevention of forest fires, have much to do with protecting our standing timber against the ravages of borers and bark-beetles. But more effective than any of these means of control is the work of our birds: and let it be clearly kept in mind that most of our birds, even the seed-eating species, are more or less insectivorous.

INSECTS

From the list below select the proper insect to fill the blanks.

1. ——— is a large insect with four wings of equal length; seeks the same food as the swallow and in the same way; larval life passed in the water.

2. —— has no pupa stage; feeds on all kinds of vegetation; becomes a great plague to the farmer; has four wings, which it folds straight down its back.

3. —— has four membranous wings; gathers honey, but does not use it in the winter; builds its nest in the ground.

4. —— is useful in getting rid of small birds and animals that die in the woods.

5. —— in the larval stage is known as a wire-worm.

6. —— is useful because it parasitises caterpillars and other injurious insects.

7. —— is a great menace to health; belongs to the two-winged insects; breeds in refuse.

8. —— is a carrier of malaria; early stages passed in the water.

9. —— has wings covered with coloured scales; flies by day; adults feed on nectar of flowers; larvæ feed on leaves of plants.

10. —— has wings covered with coloured scales; usually flies by night; useful in pollinating night-blooming flowers; but larvæ are usually very destructive.

11. —— obtains its food by sucking the juices of plants; secretes honey-dew.

12. —— wears wings for a short time only; very intelligent; lives in colonies underground or in logs; some species keep cows and slaves.

13 —— a gauzy-winged insect; larvæ feed on aphids; eggs laid each on the end of a separate stalk.

14. —— sings merrily in the pine-trees on hot summer days; larva lives under the ground, where it sucks the juices of roots.

15. —— is a four-winged insect, whose larva lives in the water, where it makes for itself a curious house out of sticks and pebbles.

16. —— has a long body and a thin waist; builds nests of mud; stores the cells with spiders that it has paralysed.

17. —— was the first manufacturer of paper from wood-pulp; although social in its habits, it is not sociable, and is generally avoided by even the small boy.

house-fly	grasshopper	cicada
dragon-fly	mosquito	aphis
solitary wasp	burying-beetle	caddis-fly
click-beetle	social wasp	bumblebee
ant	ichneumon	lacewing
moth	butterfly	

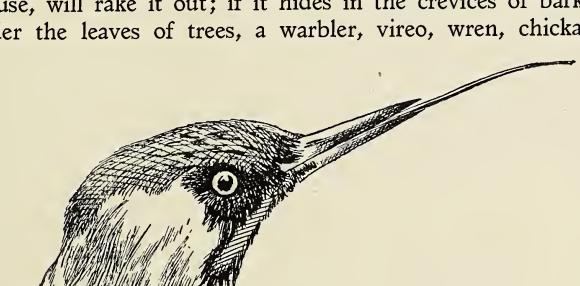
22. BIRDS AND THE BALANCE OF NATURE

With few exceptions birds are the friends of man. They are not only his friends, but his preservers; for, without them, he could no longer maintain his struggle against the hordes of noxious weeds and insects that are a constant menace to his food supply. Much emphasis is usually given to the value of birds to the farmer; but in an indirect manner, though in a very substantial degree, the city-dweller owes a debt of gratitude and dollars to the feathered world. There is no question that every class of society, even the so-called non-workers, depend for their daily existence upon agriculture, and without birds agriculture would be impossible.

The bird is so constituted that it requires and can consume an immense amount of food in proportion to its size. The number of weed-seeds consumed in a single day by one of our native sparrows is almost incredible, as also is the number of insects devoured by a tiny chickadee. Nature has created the bird to help her preserve the balance of life in wood and field. When Nature's regulating forces are undisturbed by man, a beautiful balance is maintained between plant and animal life. Even in cases where the harmony of Nature is temporarily disturbed and some particular form of life is increased beyond due bounds, Nature's balancers come to the rescue, and the equilibrium is restored.

Birds are wonderfully adapted for the particular work they are set to perform. One or more parts of a bird's anatomy may be greatly modified to perform some special task. Herons and other wading-birds are provided with long beaks, long necks and long legs; swimmers and divers, such as ducks, grebes and loons, have short legs, and their feet are more or less webbed; the woodpeckers have their hind-toes long and sharp-clawed, to assist them in clinging to bark, their chisel-shaped beaks are effective boring-tools, and their tails and tongues are also specially modified to fit the birds for their work. Many other adaptations will present themselves to the observant student of bird life.

There are few lurking-places where insects are safe from their enemy, the bird. In some time in the insect's life, as egg, larva, pupa or imago, it is likely to come within range of an exploring eye. For this reason, insects have been given many disguises or other means of evading capture. Protective colouring or form is the commonest means of defence; resemblance to scorpions or other deadly creatures, and the possession of unpalatable juices or prickly excrescences are others. If the insect hides in the ground, some scratching bird, such as a grouse, will rake it out; if it hides in the crevices of bark or under the leaves of trees, a warbler, vireo, wren, chickadee

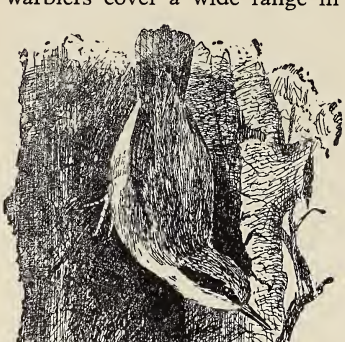


HEAD AND TONGUE OF GREEN WOODPECKER

or nuthatch is almost sure to discover it. Larvæ that bore into the trunks of trees have no assurance of safety; for the woodpecker's hearing is good, his beak is sharp and his tongue is barbed. Insects that haunt the air in forest glades fall a prey to the flycatchers; those that ascend above the tree-tops are hunted by swifts and swallows; while the forms that travel the higher air-lanes on summer evenings find their way into the maws of nighthawks.

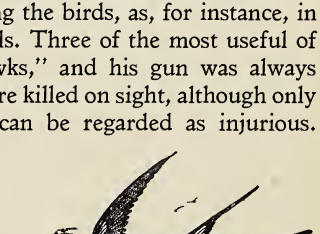
Though each kind of bird has its own favourite hunting-ground and a standard menu, it must not be inferred that they confine themselves to one special field of operations or to one class of food. I have seen a robin light on the vertical trunk of a fir and snatch a beetle out of a crevice, and a few minutes

later dart into the air after a flying ant. Chickadees, wrens and warblers cover a wide range in their explorations after insect life. Gulls will follow the plough like the crows and the blackbirds, picking up shining chrysalides and juicy larvæ from the furrows. Herons will forsake their ponds and go to the fields, where they gorge themselves on grasshoppers. In cherry and strawberry time the robin helps himself liberally to these fruits, though normally his taste inclines to cutworms and caterpillars. Even birds that may be condemned because of their grain-eating proclivities help to pay for their depredations by feeding their young exclusively on insects.



NUTHATCH

In the past the farmer has foolishly or ignorantly waged war on some of his best friends among the birds, as, for instance, in his persecution of hawks and owls. Three of the most useful of the hawks he dubbed "hen-hawks," and his gun was always kept loaded for them. All owls were killed on sight, although only one species, the Horned Owl, can be regarded as injurious. All woodpeckers were labelled "sap-suckers," and received short shrift from his hands. Then he wondered why his fields were overrun with mice and his fruit-trees infested with borers.



SWALLOW

Birds assist Nature, and incidentally man, not only by checking the abundance of insect life and in devouring thousands of tons of weed-seeds annually, but in helping to plant waste places or distant regions with

fruits too heavy for the wind to scatter. Many of our birds of prey are valuable allies in the work of destroying mice, gophers and other rodents. As scavengers, vultures, crows and gulls perform a service which should afford them protection. Some may object to the inclusion of the crow in this list; but though the crow's activities are open to suspicion when confined to inland districts, his life at the sea-shore is above reproach, and his useful labours in cleaning up the sea-beaches should give him the immunity that is extended to the gulls.

Though Governments in the past have erred in their estimate of the value of bird life to the extent of placing bounties on species that are now known to be of service to man, in recent years a complete change has taken place in the attitude of the State towards this question. The United States Government has collaborated with the Canadian Government in framing the Migratory Birds Convention Act, which is enforced by both nations and gives ample protection to the birds that were most in need of it. The setting aside of large areas as national parks, forest reserves and bird sanctuaries affords us hope that many species of birds perilously near extinction may be preserved to carry on their useful work of "keeping the balance true."

BIRDS

From the list below select the proper bird to fill the blank.

1. —— has feet fully webbed, possesses four toes, long wings; is useful as a scavenger; follows ships at sea; can swim but does not dive.

2. —— has feet partly webbed; procures food by diving; can swim well, but finds it hard to rise from the water and still harder from the land.

3. —— lives along the shores of ponds and lakes; has a long bill; flies with a quick, zigzag motion; much hunted by gunners.

4. —— preys on mice, gophers and sometimes on other birds; one species is fond of grasshoppers; flies by day.

5. —— hunts mice and other rodents; only one species lives on birds; usually flies by night.

6. —— may have either three or four toes, with well-hooked claws; climbs trees and bores into them for grubs.

7. —— lives entirely on insects, which it hunts on the wing in tireless flight; flies by day; comes late in the spring and leaves early in the fall.

8. —— is a small bird that remains in Canada all winter; lives almost wholly on insect food; has a cheerful call, from which he gets his name.

9. —— is the smallest of our birds; very quick on the wing; the male is beautifully coloured; sips nectar and extracts small insects from flowers with tubular corollas.

10. —— has a wide mouth; flies in the evening, seeking insects in the higher air; nests on the ground or on flat roofs.

11. —— catches insects from the air by darting after them; perches while waiting for them.

12. —— builds nest in fields, well hidden in the grass; the male has a sweet song; is about the size of a robin.

13. —— belongs to the thrushes; has a sweet song; builds nest partly of mud; destroys many insects, but is also fond of fruit.

14. —— eats almost anything, including corn, fruit, clams, eggs, young birds and dead animals; is regarded as a pest, but has some redeeming qualities.

15. —— is a noted singer in early spring; feeds largely on weed-seeds; must not be confused with its old-country cousin.

16. —— is noted for its beautiful colour and liquid song; builds a purse-shaped nest at the end of a swaying bough.

17. —— is one of the scratching birds; in winter eats buds of birch and alder.

chickadee	flycatcher	grebe
swallow	hawk	oriole
humming-bird	meadowlark	gull
woodpecker	snipe	song-sparrow
nighthawk	robin	crow
owl		

23. THE MINERAL WEALTH OF CANADA

I

In this age of industrialism, the mineral wealth of a country is of vital importance to its growth and development, and it is in accordance with sound business principles that we occasionally "take stock" of our assets. The task is not so simple as it looks. We know fairly definitely how much timber, what acreage of agricultural land, and the extent of water-power, we possess. But, after sixty years of exploration, prospecting, and Government research, carried on by private enterprise and by the Geological Survey of Canada, we have only a meagre knowledge of the mineral wealth of our country. Many of our richest mining properties have been discovered by the merest accident. Vast areas of northern Canada are unexplored: and still larger areas remain to be examined in the careful manner that is employed by the geologist and the prospector. So, although every year adds to our knowledge of Canada's mineral resources, at no time can we say that such knowledge is complete and final.

In theorising on the mineral statistics of a country, it is quite easy to arrive at wrong conclusions. Fluctuations in the annual output of minerals as based on their monetary value may be attributed to the following causes:

1. Production stimulated by an urgent and unprecedented demand, as in the years following the outbreak of the Great War.
2. Production normal, but a sharp rise or fall in the market value of certain metals.
3. Production reduced because of a decline in the price of silver, copper, nickel, etc.

We must remember that the value of metals and other minerals varies from year to year to a far greater extent than that of any other natural resource. This variation usually affects the output of mineral products. A drop in the market value of

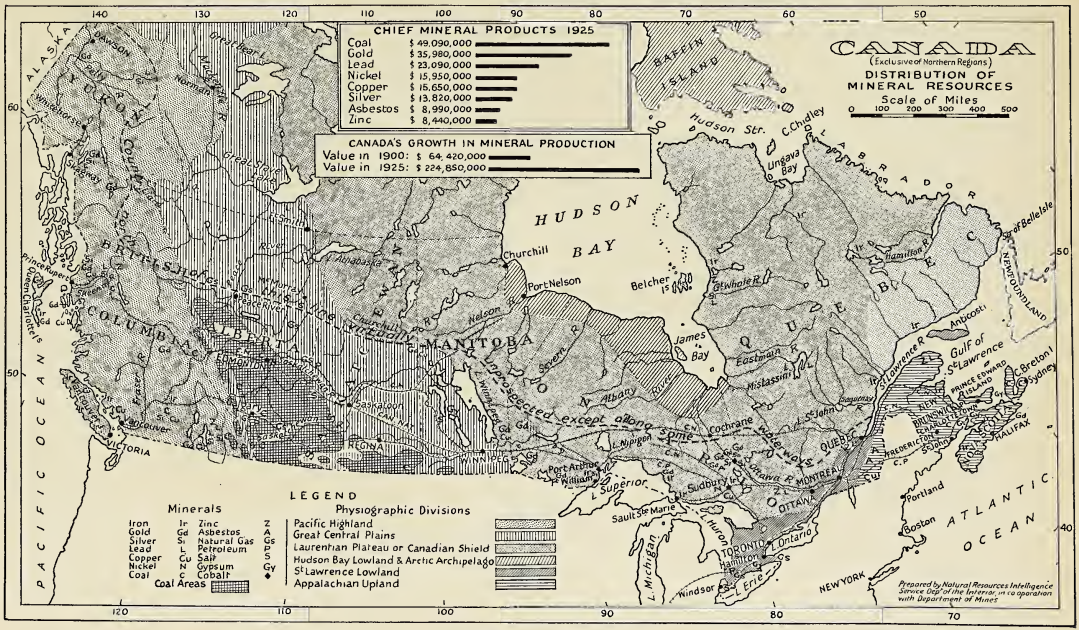
a metal, even to the extent of a few cents, may lead to the temporary closing down of certain mining operations.

Another disturbing factor, which must enter into our calculations of mineral wealth, is the question of distribution. An extensive and rich deposit of iron ore may be of little commercial value, if far removed from the coal and mineral fluxes required in smelting. England's phenomenal industrial development was largely owing to the close proximity of her chief economic minerals. But mere distance is not in itself a true criterion. Ores can sometimes be profitably transported by water when the same distance by land would debar development. We see an instance of this in the iron and steel works at Sydney, Nova Scotia, for most of the iron ore used in this plant is brought from Newfoundland. In general, accessibility and transportation facilities must be considered when estimating the value of mineral deposits.

There are few minerals of economic importance that do not occur in Canada. Yet our annual importation of mineral products far exceeds in value our export, and amounts to an enormous sum. This adverse trade balance is largely due to the following causes:

1. Our imports are largely of manufactured goods, whose value is much greater than that of the raw products which we export.
2. Capital available for investment in Canadian industries has been directed into other channels, where the returns are more immediate and less speculative than in mining development.
3. Our consumption of structural materials due to the natural expansion of a new country of vast area and sparse population.

But this phase of our national development is passing. We can look with assurance to the time, not far distant, when the outward flow of raw materials will be checked, and yet the total value of our mineral exports will be increased. This has already been accomplished in the case of forest products. Instead of feeding her forests into the maw of foreign mills,



MINERAL MAP OF CANADA

Department of the Interior

Which is the largest coal area in Canada? What are the chief mineral products of the Maritime Provinces? Find at least one location for each mineral mentioned in Sections 23 to 25.

Canada now leads the world in the export of paper. She can reach the same enviable position in the field of metallurgical and mineral development.

In spite of the fact that the mineral resources of any country, however great they may be, must diminish in quantity, and ultimately be exhausted or reduced to a point where profitable exploitation ceases, the people of Canada can confidently look forward to many decades of increased mineral development without fear of reaching, much less passing, the peak of production. The fact that other nations, long famous for their mineral wealth, are reaching the end of their resources in this field, is but an additional assurance that our mining and metallurgical activities will increase in extent and value.

Our optimism is not fanciful or ill-founded. It rests upon the tangible facts of Nature and the faith we place in the operation of her laws. The prospector with his pick and gold-pan, and his dreams of wealth; the geologist with his instruments of precision; and the investor with his cautious but calculating eye, have all gone over the field and placed their endorsement upon the sight-drafts we have drawn on the bank of hope.

In studying the mineral resources of the Dominion we must at first disregard provincial boundaries and fix our attention on the physiographic regions into which our country has been divided by the hand of Nature. These regions are five in number. Three of them are highlands or plateaux; two are lowlands or plains. The highlands are the Canadian Shield—otherwise known as the Laurentian Plateau or the Pre-Cambrian Area; the Canadian Cordillera or Pacific Highland; and the north-eastern extension of the Appalachian Highland. The lowland regions are those of the St. Lawrence and the northern extension of the Great Central Plain.

These five physiographic divisions have been explored and prospected to such an extent as to prove that each of them possesses vast stores of mineral wealth. Just what the limits of that wealth may be we do not know; for areas covering many thousands of square miles have never echoed to the prospector's pick or the geologist's hammer.

II

Science assured us long ago that the rocks of the Canadian Shield should yield unbounded riches, and every year adds confirmation to the soundness of this judgment. The Pre-Cambrian Area of Canada promises to sustain the traditions of this formation as established in other parts of the world: in the Rand of South Africa, in Australia and in India. This, the premier mining-field of the Dominion, commands to-day the attention of the whole industrial world.

Comprising over two million square miles, or over half the area of Canada, and contributing to the treasuries of all the provinces except the Maritimes and British Columbia, this region has proved its potential mineral wealth by producing, from the Sudbury nickel-copper camps alone, 85 per cent of the world's supply of nickel. From the Gowganda, South Lorraine and other camps have been drawn 350,000,000 ounces of silver. Led by the Porcupine and Kirkland Lake camps, the Ontario sector of the Canadian Shield, during a period of fifteen years, yielded over $212,000,000 in gold, the production for 1926 being $31,000,000. New camps, such as that at Red Lake, give promise of an indefinite northern extension of the Pre-Cambrian gold-bearing rocks.

In the Rouyn district of north-western Quebec are promising deposits of copper ores, which carry zinc and gold in addition. These ores are comparatively high-grade, running from 4 to 15 per cent in copper and with a gold content sufficient to pay the costs of mining and smelting. The Canadian National Railway has built a branch line to Rouyn, and a well-built town with all modern conveniences, including electric power and light, telephones, waterworks and sewers, has sprung up in the wilderness.

In the Manitoba sector of the Canadian Shield mining development is comparatively in its infancy; yet steps are being taken to rush transportation to many promising fields. In the Flin-Flon are large deposits of copper. Extensive drilling operations have been carried out on this property, proving

the existence of some sixteen million tons of ore. High-grade copper ore has been shipped from the Mandy mine at Schist Lake. Gold-bearing ores occur at Wekusko Lake in northern Manitoba. Other centres of mining activity in this sector are at The Pas and Bulldog Lake.

Other minerals of economic importance occurring in the Laurentian region are iron, cobalt, platinum, corundum, graphite, talc, feldspar, aluminium, arsenic and mica.

The Canadian Cordillera stretches northward from the forty-ninth parallel to the Arctic Ocean. It includes the whole of British Columbia and the Yukon Territory, together with western Alberta and a part of the Mackenzie district. This region is a part of the primary highland which uplifts and links together the two Americas. More than a dozen nations draw sustenance from its veins. Throughout its entire length it is famous for the variety and richness of its mineral deposits. Its veins of gold, silver and copper, opened by the Aztecs and the Incas, have continued to pour forth their riches to every succeeding generation. In the Canadian sector of this bi-continental uplift are found such famous mining-camps as the Cariboo, the Klondyke, Rossland, Kimberley, Slocan Anyox and Britannia. Up to the end of 1926 the total output of minerals in British Columbia alone amounted to $988,000,000.

The third physiographic region takes in the Maritime Provinces and south-eastern Quebec. It is formed of the north-eastern extension of the Appalachian Highland. Its contribution to the mineral wealth of Canada is considerable, and in the production of asbestos it leads the world. In Nova Scotia and New Brunswick coal is the leading mineral product. At the present rate of consumption the coal of the Maritimes is estimated to last seven hundred years. The seams are usually of great thickness, and, being located at tide-water, their output finds a ready market. Another factor that increases the value of the coal-beds of Nova Scotia is their proximity to large deposits of iron and limestone.

The gypsum deposits of the Maritimes are the most extensive in Canada. Next to coal it is the most important and valuable mineral product of these provinces. The recent dis-

covery of extensive beds of rock salt has been a great boon to the fishing industry, which alone consumes fifty thousand tons a year. A secondary use of this salt is in preserving mine timber from bacterial decay by a process of pickling. The amount of salt in this deposit is estimated at 25,000,000 tons. Gold has been mined in Nova Scotia continuously since its discovery in 1860. The gold deposits occur in a strip of quartzite and slate formation extending from Cape Canso to the Bay of Fundy. The record yield was 30,348 oz. in 1902. A recent feature in the mining activities of Nova Scotia is the production of arsenic, for which there is a growing demand as an insecticide. The province can use much of this product in her agricultural areas. The arsenical concentrates are shipped to refineries in Belgium. We cannot leave the mineral fields of the Maritimes without mentioning the famous grindstones of New Brunswick. This province, too, has large deposits of coal, gypsum, natural gas, petroleum and oil shales.

In the Quebec sector of the Appalachian region, asbestos is by far the most important mineral product: in fact it is the most valuable mineral resource of the province. The price of asbestos ranges from $22 a ton for the poorer grades to $649 for the best. The most important mines are located at Thetford, Black Lake and Danville. Most of the asbestos is shipped in the raw state to Europe and the United States. Asbestos products manufactured in Canada are confined to the poorer grades and amount to only 5 per cent of the output of this mineral. Fireproof shingles and wall-board are now made from a mixture of asbestos and Portland cement. It is also used for packing, pipe covering, textiles and brake-band lining. In the Eastern Townships copper mines are being operated at Weeden and Eustis. In the Gaspé Peninsula are deposits of zinc and lead.

The lowlands of the St. Lawrence include portions of south-western Quebec and south-eastern Ontario. This region is chiefly devoted to agriculture and manufacturing, but is none the less a large producer of non-metallic minerals. These include petroleum, natural gas, salt, gypsum and structural materials.

The remaining region, that of the Great Central Plain,

extends from the forty-ninth parallel to the Arctic Ocean, and lies between the Canadian Shield and the Cordilleran Highland. Its rocks, like those of the St. Lawrence lowlands, are of sedimentary formation. They contain non-metallic minerals of great extent and exceptional value. Coal, from lignite to anthracite, underlies large areas of the Prairie Provinces; and the reserves of coal in Alberta are the largest in Canada. In southern Saskatchewan are found extensive beds of refractory clays, which are being used in the manufacture of fire-brick, sewer-pipe, etc. Reservoirs of natural gas in commercial quantities

Department of the Interior

OIL WELLS IN ALBERTA

have been tapped and used over wide areas. In the northern part of Alberta there are valuable deposits of bituminous sands. Petroleum has been found in widely separated areas of this mineral belt; in the north at Fort Norman, and in the south near Lethbridge, with promising borings in between.

With the modern trend of industrialism pointing to an ever-increasing demand for mineral products; with our immense reserves of the most essential metals and non-metalliferous deposits; with our central position in regard to world markets, together with our vast natural resources in timber, agricultural land and water-power, the Canadian people can look forward with confidence to an era of unprecedented industrial development and national prosperity.

24. THE MINERALS OF ONTARIO

Much of the prestige which our country enjoys among the nations of the earth, much of her solidarity as a self-governing state, and much of her importance as a link in the chain of empire that encircles the earth, she owes to the steady advancement in the utilisation of natural resources attained by the people of Ontario. Here the pioneers cleared the forests and made their province the garden of Canada. For years her leading industry was agriculture, which she brought to a high state of efficiency by the introduction of scientific methods. But she did not neglect other industrial opportunities. Her manufacturers kept pace with her agriculturists, in spite of the fact that they lacked at least two of the essential elements of success in this difficult field—coal and cheap labour. With imported coal and, after 1895, with imported iron ores, Ontario produced agricultural implements, tractors and mill machinery, not only sufficient for local needs, but for shipment to other provinces and for foreign export. Her forests, too, yielded rich rewards to a race of lumbermen unexcelled in any part of the world. When the use of hydro-electric power promised to remove one of the chief handicaps to her manufacturing, Ontario was quick to utilise this great natural resource, "white coal."

It was in the development of her vast stores of mineral wealth that this enterprising province next set a high standard of achievement. At the time of confederation Ontario's mineral output was almost negligible. The regions that have since proved so rich in metalliferous deposits were then uninhabited except by scattered bands of Indians, and unknown except to venturesome trappers. The early prospectors who went to distant lands in search of gold did not dream of the wealth they were leaving behind. For many years the great Northland hid and guarded her treasures: but at last, almost by accident, her secret was revealed. When a railway was being built through those northern wilds, a rock-cut laid bare the

world's largest deposit of nickel, and a new era dawned in the industrial life of Canada.

In 1886 the value of the total mineral production of Canada was $10,321,331; in 1926 it was $241,245,898, to which Ontario contributed $85,364,921, or nearly twenty million dollars more than any other province. Nature, of course, must be given due credit for having provided the raw material out of which this vast wealth has been created; but it required courage, enterprise and vision to put in the initial capital and labour necessary to develop this most speculative of natural resources.

Rocks of the Pre-Cambrian era, so rich in valuable mineral deposits, underlie the whole of northern Ontario. It is naturally in this field that we must look for the greatest mining activity. Southern Ontario, however, has also contributed many humble but useful products to swell the total mineral output of the province. Rocks of sedimentary origin underlie the fertile fields of this section. In these underlying strata are found such valuable non-metallic substances as petroleum, natural gas, oil shales, rock salt, clay, gypsum and limestone. Perhaps no clearer conception can be formed of the magnitude that mining operations have assumed in the industrial life of Ontario than by reviewing the actual exploitation of the various minerals that occur in that province. These may be conveniently classified into three groups: the metallics, the non-metallics, and structural materials.

Gold.—Though all her deposits are in the form of lodes, Ontario has outstripped British Columbia and the Yukon in the production of this precious metal. The Porcupine and Kirkland Lake camps are the heaviest producers. The former camp became a steady contributor to the industrial revenues of the province in 1909; and the Kirkland camp four years later. The chief mines in the Porcupine group are the Hollinger, Dome and McIntyre. The Hollinger has the reputation of being the second largest producing gold mine in the world. Even richer, though less extensive, are the deposits at Kirkland Lake. With recent discoveries at various points, ranging from the Temiskaming district to Red Lake, there is strong assurance of an increased production of gold for many years to come.

Before the discovery of the rich lodes at Porcupine and Kirkland Lake, Ontario's most promising goldfield was in the Lake of the Woods region.

Silver.—Ontario has long been famous for her mines of silver. The Silver Islet mine in Lake Superior was one of the most notable. For years it had the reputation of being one of the richest silver mines in the world. The vein was followed to a depth of five hundred feet below the level of Lake Superior. Between the years 1869 and 1885, some four million ounces of silver were taken from this mine and others in the Thunder Bay district. But these early triumphs seem almost trivial when compared with the phenomenal output of recent years. In 1911 Ontario mines yielded 30,540,754 oz. of silver, which stands as her maximum annual production. The unrivalled Cobalt deposits were discovered in 1903, and from this date to the end of 1922 they produced about three hundred and twenty-five million ounces of silver, and the mining companies operating them had paid out in dividends and bonuses over eighty-six million dollars.

The market price of silver is more variable than that of gold. Disturbed conditions in the Orient were responsible for the sharp decline in the price of this metal which marked the closing months of 1926. In 1925 the average price of silver was 69·065 cents per ounce: this average dropped to 62·107 cents in 1926, the lowest point, 53·466, being reached in December of that year. For the first time in many years Ontario's output of silver fell below that of British Columbia, a significant fact which we must try to account for when we study the mineral production of the Pacific province.

The silver ores of northern Ontario are somewhat complex, containing a large amount of native silver, together with various compounds of this metal. Nickel, cobalt and arsenic are important by-products of these ores. Silver, too, is found as a by-product in many of the ores of gold, nickel and copper, and is recovered in the refineries where these ores are treated.

Besides the Cobalt group, promising silver properties are located at South Lorrain, Gowganda, Casey Township and Elk Lake.

Nickel.—This metal is rarely found in a pure state. The purest deposits occur in the island of New Caledonia, from which source came most of the nickel used in Europe prior to the discovery of the rich ore bodies in northern Ontario. Now over eighty-five per cent of the world's supply of this metal comes from the Sudbury and Alexo mines, located in the Ontario sector of the Canadian Shield.

In addition to nickel, the ores at Sudbury contain iron, gold, silver, platinum, palladium, and three or four rarer metals. These precious metals are recovered as by-products in the process of refining the smelted ore. The corporations that control the nickel industry in Canada operate smelters at Copper Cliff, Coniston and Nickelton. The refining is done at Port Colborne, Ontario; Deschenes, Quebec; and at Clydach, Wales.

The use of nickel in the manufacture of armour-plate stimulated production to such an extent during the Great War that the output in 1918 reached 92,507,293 lb. The average annual production for the four years previous to the war had been 41,472,000 lb. As might be supposed, when peace was declared a sharp decline took place in the production of nickel. But there are so many uses for this metal in the industrial arts that the demand for it is steadily increasing, and in 1926 the province produced 65,700,000 lb.

Cobalt.—Like nickel, this metal was regarded as a sort of evil spirit by German miners. It was associated with silver in the mines of Saxony, and for a long time was considered worthless. The oxide of cobalt was first used for colouring glass in 1540. Even to-day the blue colours used in the manufacture of glass and porcelain are derived from this metal, being more permanent than any others yet discovered. Ores containing cobalt are very complex. In Ontario the metal is chiefly associated with silver, nickel, arsenic and sulphur. Its occurrence is not confined to the Cobalt district: from the nickel-copper ores of Sudbury it was formerly extracted as a by-product. But most of the world's supply comes from the former area. The separation of this metal, involving very complicated processes, is carried out in the refineries at Thorold and Deloro.

Cobalt, chromium and tungsten are components of the alloy stellite, which is used in the manufacture of cutting-tools that operate at high speed. A superior grade of cutlery, not subject to rust or corrosion, is also made from this alloy.

The production of cobalt naturally fluctuates with the demand for silver. In 1922 the total output, in the form of metal, alloys, oxide and salts, was 569,960 lb., valued at $1,852,370. In 1926 the value of the output had diminished to $1,116,000.

Copper.—This metal, so useful in the industrial life of to-day, is widely distributed throughout Canada. Extensive deposits occur in Ontario, but the production is largely from the nickel-copper ores of Sudbury. The output for 1926 was 48,750,000 lb. The ores are treated by the smelters and refineries already mentioned.

Lead.—Though deposits of galena are found in various parts of Ontario, only one mine is producing lead in extensive quantities: this is the Kingdon mine, at Galetta, on the Ottawa River. Zinc blende is associated with the lead, and a certain amount of zinc is obtained as a by-product.

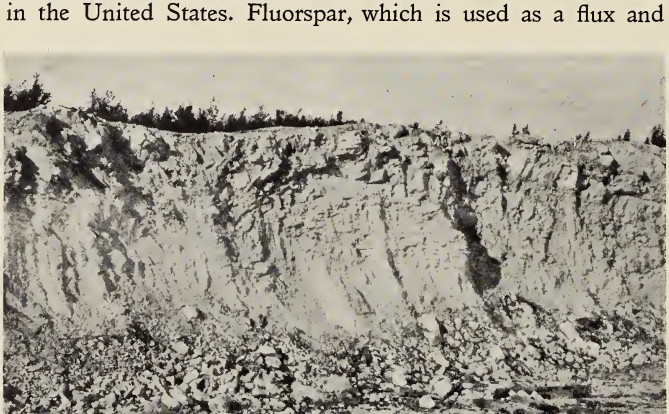
Other Metals.—Metals of the platinum group—platinum, palladium, iridium, rhodium, ruthenium and osmium—are found in minute quantities associated with the Sudbury deposits. From this source Canada obtains her chief supply of platinum.

Owing to her lack of coal Ontario has not as yet been able to utilise her large deposits of iron ore to any great extent. But it is quite probable, judging from recent experiments carried out by the Department of Mines at Ottawa, that eventually an electro-chemical recovery of iron from these ores will prove a commercial success.

Non-metallic Minerals. — Corundum is a hard mineral, formerly much used in the preparation of abrasives. Deposits in the counties of Renfrew and Hastings were profitably worked for a number of years, the total production since 1900 amounting to over two million dollars. But the use of artificial abrasives, such as carborundum, has lessened the demand for the natural mineral, and most of the corundum mines have ceased operation. The manufacture of artificial abrasives, however, has

developed into an industry of some importance, the six firms engaged in it producing goods to the value of $9,500,000 in four years. Unfortunately, up to the present time, much of the raw material, bauxite and silica, has to be imported.

Large deposits of feldspar of high grade are found in many parts of Ontario. This mineral is shipped chiefly to potteries in the United States. Fluorspar, which is used as a flux and



Department of the Interior

GYPSUM CLIFFS

for other purposes in metallurgical works, has been mined in Hastings County, though so far the output has been small. Graphite is another useful mineral found in south-eastern Ontario, where it has been mined for many years.

But the most important non-metallic minerals of Ontario are found in the south-west, between Lake Erie and Lake Huron. These, in the order of their commercial value, are natural gas, salt, gypsum and petroleum. For over thirty years gas has been used in the towns and cities of this district for domestic and industrial purposes. The production of natural gas in 1926 was over seven thousand million cubic feet, valued

at over five million dollars. To the north of the gas-field are extensive beds of rock salt, lying at depths varying from nine to eighteen hundred feet. At such centres as Windsor, Sarnia, Goderich and Kincardine the salt is obtained by evaporating the artificial brines produced from borings down which water has been forced by powerful pumps. In 1926 the production of salt in Ontario was over two hundred thousand tons.

The counties of Lambton, Middlesex and Wessex produce most of the petroleum as yet found in Canada. Petrolea, Oil City and Bothwell are the chief centres. Benzine, naphtha, vaseline, dyes and wax are obtained, or manufactured as by-products. In 1926 the production was 137,000 barrels, valued at $377,000.

Gypsum, or sulphate of lime, used both in agriculture and the arts, is mined in several places along the Grand River. The annual output is valued at about half a million dollars. Plaster of Paris is made from this mineral.

Of structural materials, such as cement, lime, clay products and stone, Ontario's annual production is valued at about eighteen million dollars, which is over 25 per cent of the value of her total annual output of minerals.

25. THE MINERALS OF BRITISH COLUMBIA

MINING in British Columbia really began with the output of three thousand tons of coal at Departure Bay, on Vancouver Island, in 1852. On the mainland the gold rush to the Fraser in 1858 marks the beginning of mining activities, that have continued to the present day, and promise to yield increasing riches for many years to come. In the first year of the rush, $705,000 in placer gold was taken from the bars and creeks of the Lower Fraser. As the army of prospectors panned their way up this turbulent river, they were rewarded with increasing values until, in 1861, they "struck it rich" in the creeks of Cariboo. By 1863 the output of placer gold had risen to $3,913,563.

But the productive life of a placer camp is short. When "pay dirt" begins to wane in value the restless prospector pushes on in search of more alluring fields. The Cariboo excitement gave way to that of the Omineca country, and rich strikes in the Cassiar followed. Last of all came the Yukon and the trail of '98.

The pick follows the gold-pan, and the patient searcher after "mother lodes" was in time rewarded. Lode-mining in British Columbia began in the early 'nineties when, after intermittent development of the Le Roi and other claims in the Rossland camp, the main pay chute of the War Eagle was struck in 1894. Two years later the smelter at Trail was constructed, and development on a large scale was begun on such famous claims as the Le Roi, War Eagle, Centre Star and Iron Mask.

The success of this camp led to rapid development of promising claims in adjacent fields of the Kootenays and the Boundary country. Slocan, Nelson, Lardeau, Trout Lake, Ainsworth, Fort Steele, Greenwood and Grand Forks became centres of mining activity. In the Slocan-Ainsworth district are found the Sandon and Silverton camps, which in 1926 produced 1,078,712 oz. of silver and 8,027,475 lb. of lead. In the same year the Fort Steele district, which contains the celebrated Sullivan mine, produced 4,942,364 oz. of silver, 250,050,057 lb. of lead, and 127,750,444 lb. of zinc. The faith that the early mining operators had in this district has been fully justified.

The building of the Crow's Nest Pass Railway in 1897 did much towards stimulating mining activity in eastern and southern British Columbia. It not only provided transportation for the output of the numerous mines, but by opening up the coal-fields of East Kootenay provided the smelters with an unlimited supply of cheap fuel.

The province of British Columbia is divided into forty-two mining divisions, which are grouped into six districts.

In 1926 the total mineral production of the province was $67,188,842.

The minerals that contributed this large sum to the national

Department of the Interior

BRITANNIA MINE

wealth, arranged in order of value, are: lead, copper, coal, zinc, silver, gold, structural materials and miscellaneous.

Lead.—The total production of this metal in 1926 was 263,023,937 lb., or nearly 10 per cent of the world's annual output. Over 95 per cent of the provincial production came from the Fort Steele division of the Eastern District, the chief mines contributing being the Sullivan, Stemwinder and St. Eugene.

Copper.—The quantity produced in 1926 was 89,339,768 lb., derived chiefly from the Granby Company's mines located in Nass River and Similkameen divisions, and from the Britannia mine in Vancouver division.

Coal.—2,330,036 long tons of coal were mined in 1926. Most of the output came from collieries on Vancouver Island and at Crow's Nest Pass, Nicola and Princeton. Over 12 per cent of the coal produced was exported to the United States. Coke is no longer regarded as a primary mineral product. The total quantity of coke made in British Columbia during 1926 was 177,269 long tons, valued at $1,437,666. The value of gas, tar and other by-products of the coke industry was over a million dollars.

Zinc.—Though zinc was extracted from the ores of seventeen mining divisions, about 90 per cent of the output of 142,876,947 lb. must be credited to the Fort Steele division, in which is located one of the most extensive lead-zinc deposits in the world. As might be supposed, the Sullivan mine was the highest producer. This property is equipped with the latest devices and machinery for the mining, crushing, separating and concentrating of the ore, and the recovery of the zinc by the electrolytic process.

Silver.—The output of silver in 1926 was the largest in the history of the province. For the first time in many years British Columbia surpassed Ontario in the production of silver. This was largely due to the increased output of the Sullivan mine: for, though the ores of this property are mainly worked for their lead and zinc content, a considerable amount of silver is recovered as a by-product. The Portland Canal division was also a large producer of silver, most of it coming from the

Premier and Hidden Creek mines. The total provincial output for 1926 was 10,748,556 oz., valued at $6,675,606.

Gold.—Most of the romance of mining has been connected with the search for alluvial gold. The sight of a nugget fires the blood of the oldest prospector. And yet, when we get down to cold-blooded statistics, the actual value of the gold recovered from alluvial deposits is comparatively insignificant. The total yield of placer gold to date in British Columbia has been a little over seventy-eight million dollars. The peak of production was reached in 1863, when the output amounted to $3,913,563. In 1926 the placer gold recovered was worth only $355,503, while the gold from lode-mining amounted to $4,163,859. Most of the alluvial gold was obtained from the placers of Cariboo, Quesnel and Atlin. Over 60 per cent of the lode-gold came from mines in the Portland Canal division, the Premier being the largest producer.

Structural Materials.—Owing to an increased activity, not only in the building trade, but in all branches of construction, there has been a good demand for structural materials. Common brick, firebrick, stone, lime, sand, gravel, crushed rock and cement to the value of $3,342,583 were used or marketed during 1926. At Tod Inlet and Bamberton there are large plants for the manufacture of high-grade Portland cement. Much of the stone used in the construction of the Parliament Buildings at Victoria came from the quarries at Haddington Island; and a very fine quality of granite for structural and building purposes is obtained from Nelson Island. Pulp-stones for use in the pulp-mills of the province are made from sandstone quarried on Newcastle Island. On Howe Sound and Burrard Inlet are three large plants for the production of rock and gravel used in making concrete. These plants are fully equipped with powerful crushers and hydraulic machinery for washing the gravel.

Miscellaneous Minerals.—Although there are large deposits of iron in British Columbia, about 7,485,000 tons having been officially recorded, there is at present no market for this valuable mineral. Platinum is obtained in variable quantities from the placer mines on the Tulameen River. Pyrite is now being utilised by the Sullivan mine for the manufacture of sulphuric

acid. From concentrates of the Nickel Plate mine arsenic to the value of over eleven thousand dollars was recovered as a by-product in the process of smelting. Gypsum occurs in several localities, but the principal output, amounting to $154,462 in value, was obtained from Falkland, near Kamloops. Carbonate of soda is now being obtained from lakes in the Clinton division, and silicate of alumina, used in the manufacture of high-temperature cement, is obtained from deposits in the vicinity of Williams Lake.

MINERALS

From the list below, select the proper mineral to fill the blanks.

1. —— is usually associated with lead, resists corrosion and is used in the making of galvanised iron.

2. —— is much used in electrical work and in the making of bronze. It is also used for cooking utensils.

3. —— is manufactured from non-metallic substances and is the most important mineral product in construction work.

4. —— is unaffected by weather or acids and is both malleable and ductile. Its specific gravity is second highest among the minerals.

5. —— is used in the manufacture of rustless steel, and is commonly employed in the making of permanent blue paint.

6. —— is a heavy mineral used in the manufacture of paints, glass, electric batteries and poisons.

7. —— is a vegetable product used extensively in industries of all kinds; it is the most valuable mineral in Canada.

8. —— is the heaviest of metals and has similar properties to gold. In addition to the manufacture of jewellery, it is used in making electrical apparatus.

9. —— is used in the making of stoves and in the manufacture of steel.

10. —— is of great value in the manufacture of steel for armour-plate. The chief world's supply of this metal is found in Ontario.

11. —— is used in the manufacture of fire-proof fabrics. The world's chief supply of this mineral comes from Quebec.

12. —— differs from gold in being affected by the weather and acids. It is the second mineral in value in currency.

13. —— is used in the preservation of food, particularly of fish, and is also used in small quantities as a food.

14. —— is used in the manufacture of bricks and sewer-pipes.

15. More by-products are obtained from —— than from any other mineral, gasoline being one of them.

16. —— is used as a fertiliser, and from it is manufactured plaster of Paris.

gold	lead	cement
silver	iron	clay products
copper	platinum	gypsum
nickel	asbestos	petroleum
cobalt	coal	salt
zinc		

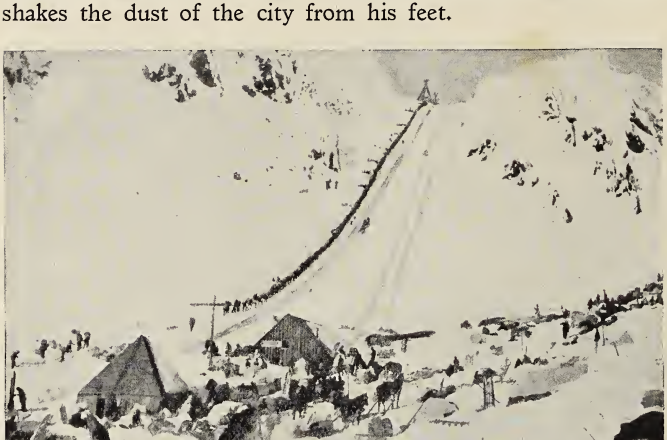
26. THE PROSPECTOR

WHATEVER of romance and high adventure there is in the mining industry is centred in the lives of the prospectors, those heroic men who, forsaking the companionship of their fellows and denying themselves the comforts of home, strike out into the untrodden wilderness to seek the fulfilment of a dream. They are men endowed by Nature with the dauntless courage, the faith in themselves and the imperishable fire of hope that are necessary to carry them through years of discouragement, hardship and failure to the goal of triumphal success. But they are something more than mere visionary seekers after wealth. Consciously or subconsciously they realise that living and striving towards an ideal are more important than its attainment.

The waste places of the earth are the prospector's true environment. There he is as much at home as the mountain marmot or the desert fox. He is in tune with the voices of Nature: the harp-like music of the pines, the roar of cataracts, the thunder of avalanches and the songs of birds. The smell of sage-brush is sweeter to his nostrils than the incense of cities. On an armful of fir-boughs he can sleep with greater ease than on a bed of eider-down. He has a keener appetite for flapjacks and bacon than a king has for caviare.

When his dream comes true and he "strikes it rich," the prospector may plunge for a time into the whirl of city life,

spending his money with a reckless abandon; but he knows in his heart that this is not the fulfilment of his dream. The voices of the hills keep calling him back to his heart's desire. When his last few dollars have been spent in a "grub-stake," he shoulders his pack or loads a string of cayuses and literally shakes the dust of the city from his feet.



Department of the Interior

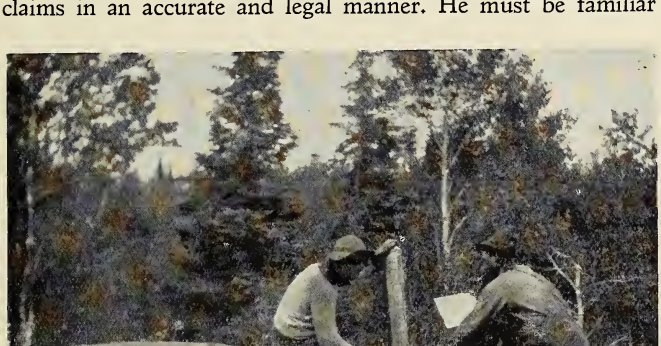
THE KLONDYKE GOLD RUSH

Prospectors pouring through the Chilkoot Pass.

But it must not be supposed that the prospector is a species of glorified tourist who travels through the hills in search of spectacular sunsets, good health and a vigorous appetite: nor that he spends his days listening to the songs of birds and regaling his nostrils with the aroma of pines. For, though he may on occasion squander his money unwisely, he has a clear business-like sense of values where minerals are concerned. He knows only too well that the measure of his success will be reckoned in dollars and cents: and success is his lode-star.

So, to be a prospector, a man needs something more than

a geologist's hammer, a miner's pick and a gold-pan. He needs a varied knowledge of several arts, crafts and sciences. He must know enough of chemistry and metallurgy to be able in the field to make his own assays. He must know the common rock formations, their mineral contents, and the changes they undergo when exposed to the forces of Nature. Of elementary surveying he must know enough to enable him to stake out his claims in an accurate and legal manner. He must be familiar



Department of the Interior

STAKING A CLAIM

with the mining laws of the province or territory in which he is operating. In addition, he must be a good woodsman, a skilful hunter and a keen observer.

In the various "gold rushes," such as that of '49 in California, of '58 on the Fraser, of the '60's in Cariboo, and of '98 in the Klondyke, men who knew absolutely nothing of these matters joined in the stampede. By accident a few of them "struck it rich"; but the real successes came to the men who knew what to look for, and where and how to look for it. In all these "rushes" placer gold was the objective; and prospecting for placers is comparatively simple. The only essential equipment required, in addition to the usual camping outfit, is a

gold-pan. By means of this the prospector can pan out the alluvial deposits in which he hopes to find gold. In rich diggings he can soon tell whether it is worth his while to stake claims. After the staking is done, he must hurry to the nearest mining-recorder's office to record his claims. But later he must return to develop his claims, carrying his operations down to bedrock if possible; he puts off the rôle of prospector and becomes a miner.

Though the prospector is naturally always on the look out for placer gold, his attention must be mainly directed to the outcrops of rock in place; for it is in veins or lodes that he is most likely to find the consummation of his hopes. His equipment for this type of prospecting must be more extensive than the one just described. In addition to compass, axe, hammer and gold-pan he will require drills and dynamite, with the necessary fuse and caps, and a portable assaying outfit, containing a balance with weights, muffles, crucibles and scorifiers, and other instruments.

To carry such a complete outfit into the wilderness, the prospector will require one or more pack-horses. When he reaches a district that looks promising, he will make a base camp where there is feed for his horses, probably in a valley or mountain meadow near a stream. Working from this camp as a base, he will carefully explore not only the hills but the valley itself, including all the creek beds and dry watercourses that intersect it. If he finds "float" that looks promising, he follows it up until it disappears. At this point he must carefully examine all outcrops on the mountain slopes to see if he can locate the vein from which the float came. Gullies and the bare backbones of ridges are the most likely places. When he finds pieces of the same kind of float well up the slope he knows he is close to the lode. The vein or lode itself may be masked by detritus, which he will have to clear away. This often involves much hard work, and often ends in disappointment; but these are incidental to the life of the prospector.

Should he be successful in locating the vein, he must uncover it to such an extent that he may ascertain its "strike" or direction. By running a compass line along its course he is likely to

meet with it in other outcrops. But whether he meets with it again or not, he will lay out his claim in the general direction or strike of the vein.

As the surface ore in a lode is often very unreliable for purposes of determining the value of the claim, the prospector usually puts in a few shots and takes samples right across the vein. Taking these samples to his camp he proceeds to assay them. Of course, if the ore plainly contains free gold, the prospector will powder the rock and pan it out as he would in alluvial deposits. Putting the crushed rock in a gold-pan, he pours in water and then shakes the contents with a rotary or oscillatory motion, tilting the pan at the same time and adroitly getting rid of the coarser and lighter materials. He repeats this until there is nothing left in the bottom of the pan but the heavier ingredients of the ore, such as iron and gold. If the iron is magnetic it can be lifted by means of a magnet; if not, it can be blown away when dry.

The prospector has many weighty things to determine after he has made his assay. He must consider the probable extent of the ore body, its accessibility, the proximity of necessary fluxes, the presence of other constituents, such as arsenic or antimony, and the probable cost of mining the ore. He must not depend upon his own crude assays; samples taken right across the vein must be submitted to a reliable assayer. The hardest work of all, perhaps, is the obtaining of capital to develop the claim. After a season of strenuous effort in the hills, the poor prospector often returns to the city to find a slump in the mining industry and no sale for his property, however good it may be. But he usually manages to raise another grub-stake, and with the melting of the snows you will see him, full of hope and enthusiasm, leading his pack-horse along some lonely mountain trail.

Department of the Interior

SLUICING GOLD

27. GOLD-MINING

"MINING for gold" is a phrase which has for most of us the same lure and appeal as the buccaneer's slogan, "pieces of eight." For some reason we do not associate it with present-day activities in our own land: we relegate it to a remote and romantic past and to far distant lands. It recalls to us the stories of the Arabian Nights, the land of Ophir (wherever that might be), and the Spanish Main. When we have mentally rolled in these fabulous riches of bygone times, we may perhaps direct our thoughts to such modern fields as California, Australia or South Africa. We read of the Rand and we vision a ridge of gold stretching, perhaps, from Kimberley to Johannesburg. Only by an act of our will can we bring ourselves into contact with the vital here and now, the possibilities and potentialities of our immediate environment.

Even the prospector, who at least has faith that gold may lie under his feet, clings to these mythical mines of "far away and long ago." When, after patient searching, he discovers a vein and stakes a claim, he calls it the Aladdin, the Eldorado,

the Captain Kidd, or the Queen of Sheba—some name associated with his dreams and visions. After treading on air, and living on little else for many days, he descends into some modern city—let us be definite and say Toronto—and tries to sell his claim, his dream-mine. Naturally he puts upon it a high price, for to his imaginative eye it is indeed an Eldorado, a glory-hole for the gods to play in. But in the end he probably sells it for a few drinks and a grub-stake sufficient to take him back into his beloved hills.

The man who buys the prospector's claim has no romantic visions. He has thrown away a few dollars in a gamble—less than a hundred to one shot, he figures it—but nevertheless worth taking. He goes himself or sends a mining engineer, whom he trusts (more or less) to examine the prospect, obtain samples for assays, and report upon the nature, extent and locality of the claim. When the ore is assayed, and the values per ton figured, even the pessimistic eye of this wary speculator shows a gleam of interest. He realises that he has bought an Eldorado for less than a song.

Before many days have passed a gang of men are stripping a six-foot vein on the mountain-side where the old prospector had his visions of the magic lamp and the rainbow-pots of gold. Roads and camps are built, diamond drills, air-compressors and engines are brought in and installed. The development of a mine that is to make history has begun. Far away in the distant hills, the old prospector, whose mind is filled with new visions of wealth, sees the smoke and hears the reverberating blasts that are rending the gold-laden rocks, and he wonders what it is all about. Fortunately for his peace of mind he goes out by another trail, and it is years afterwards that he passes through a new mining-town that has sprung up on the site of his original Eldorado.

In wonder he gazes at the huge mill in which thousands of tons of ore per day are pounded into fragments in crushers, reduced to still smaller pieces in grinders, smaller yet between giant rollers, and still finer in the rod and tube mills, until the solid rock has been reduced to the consistency of slime. In perplexity he turns to a man at his elbow:

"What is it all about, partner? Do they make bread out of rocks nowadays, or has this something to do with mining?"

"Has this something to do with mining? Say, old-timer, this is one of the biggest gold mines in the world. We aim to make it the biggest before very long. Are you interested in mining?"

"Well, in a way: I am a prospector, but we don't know very much about the mining end of it. Years ago I staked a mine somewhere hereabouts and got a grub-stake out of it."

"What was the name of your claim?"

"I think I called it the Eldorado, or it might have been the Aladdin."

"What? The Eldorado? Why, man, you are standing on it! That is the claim that formed the nucleus of this mining-field. Up to date it has produced over a hundred million dollars in gold. And you mean to say that you staked this mine?"

"I reckon I did. I sold it to a man named Hutton for a hundred-dollar grub-stake, and I thought he was generous to give it to me."

"Hutton, eh? Let me see: he put in a small plant and developed the property for a year or two, when he sold out to the present syndicate for two hundred thousand dollars. They had the whole property thoroughly prospected with diamond drills and found they had an ore-body which justified their putting in the extensive plant you see to-day."

"Why, the assays I made didn't run very high, maybe six or seven dollars to the ton. I don't see how they have made it pay."

"Big production, six thousand tons a day, and a system of operation that cuts out all waste in material, time and labour, is the answer. It would take two or three days to show you all there is to this plant; but if you care to listen, I can give you a general idea of the system we use at the Eldorado."

"I don't know much about mining, as I told you before, but I certainly would like you to tell me how they get the gold out of this rock."

"Well, the place in which you stand is the mill, where the ore is crushed, ground, cyanided and filtered. With the re-

finery, the engine-houses, machine-shops, offices, laboratories, and other buildings, the surface plant of the Eldorado covers a thousand acres. The underground workings, consisting of shafts, levels, cross-cuts, and so on, if stretched out in a straight line, would reach a hundred miles. There are sixty miles or more of underground railways to carry the ore from the various veins that are being worked. These veins are eighty in number——"

"Eighty! Why, man-alive! I found only one."

"Not all veins outcrop at the surface, as you probably know. The one you struck was a little less in value than the average. We have some that run pretty high, twenty-five dollars to the ton or over. But every ton of ore that comes into this mill carries eight dollars in gold."

"How do they manage that when the values are so different?"

"All the ore from all the veins that are being worked is carried to a central crusher located at the 1550-foot level. Rich ore and poor ore are mixed together in such proportions that every truckful coming to the mill runs eight dollars to the ton."

"I don't see how they can tell what values the ore from each vein will run on each particular day. It might be more on some days than on others."

"So it is; but in the laboratories assays of the ore being taken out are made, not once a day, but every few minutes. They know exactly what values the ore-cars from a certain vein carry every hour of the day. There is no chance or guess-work in the running of the Eldorado. The shareholders can figure up their profits as three dollars and seventy cents on every ton of ore that is treated in the mill. You sold this mine for less than it yields in profits every seven minutes in a day of twenty-four hours."

"Well, don't rub it in, partner. I'm not going to lose any sleep worrying over lost opportunities. They are welcome to anything they make. I have my compensations which they know nothing about. But go on."

"I didn't mean to rub it in, old-timer, but it seems a shame you got so little out of this bonanza. However, we will now trace the ore from gangue to bullion. Eighteen hundred men

work underground and nine hundred on the surface. Drills driven by air-compressors bore the holes, which eat up two hundred boxes of dynamite a day. These drills are eight to ten feet long. There is a special machine-shop where these drills are resharpened, four thousand of them being treated every eight hours. The ore that is broken down is shovelled into dump-cars, which are drawn by powerful but diminutive electric locomotives to the mixing-point at the 1550-foot level. From the higher levels the ore descends to this point by chutes. Overhead trolleys are used. Although there are twenty shafts in this mine, all ore comes up the main or central shaft.

"The ore-buckets that carry the mixed ore to the mill have a capacity of six tons. They are of the self-dumping type, that is to say they dump their load automatically into the surface crushers. From these the ore passes to the grinders, receiving in transit a quantity of lime. Steel cylindrical rollers next reduce the ore to the size of marbles. In this condition it descends to a huge storage bin, situated sixty feet underground and containing fifteen hundred tons. This bin is always full and yet is always being emptied. In case anything goes wrong with the works, the ore in this reserve bin will keep the mill in continuous operation until repairs are effected."

"How do they get this ore out of the underground bin?"

"There is an inclined roadway leading to the top of the mill. Along this two ore-cars, each with a capacity of seven tons, carry the ore to a point where it is sprinkled with a solution of cyanide of potassium. In the rod mills it is reduced to the consistency of coarse sand, and from them it passes to the tube mills, where a further dose of cyanide is added. When it leaves these mills it has been reduced to a substance that resembles mud in a liquid form."

"No one would think that this stuff contains gold."

"That is so: but nevertheless it does, as we shall see. From the tube mills the ore passes to huge tanks, fifty feet high, called agitators. The agitation is done by compressed air, which is forced into the tank, and the process of agitation is kept up for twenty hours."

"Why do they have to agitate the ore in this way?"

"So that the cyanide can dissolve all the available gold in the ore."

"You say, all the available gold. There must be some of the gold, then, that is not recovered."

"About four per cent. But it would cost more to extract it than it is worth. The mixture from the agitators is washed and separated into a clear liquid and a muddy residue. The clear liquid, which, by the way, is a deadly poison, is conveyed to separate tanks, from which it is fed to the box-like filters; but before it reaches them it receives a definite amount of powdered zinc. The filters consist of sheets of paper-covered canvas. These catch the gold and zinc and allow the cyanide to pass through. This solution of cyanide is conveyed back to the rod mills, where its strength and its work are renewed."

"How often do they make a clean-up?"

"Once a week. The sludge that contains the gold is removed from the filters. Besides the gold it contains, of course, the zinc and a certain amount of silver. From the mill it goes to the refinery, where it is smelted and the gold poured out into moulds in the form of bars or bricks. Each brick is worth about twenty-five thousand dollars; and if they handed you one, old-timer, it would be no more than an act of justice."

"An act of charity, and I want none of it. But what happens to the immense amount of tailings they must produce from an output of six thousand tons a day?"

"There is no room near the mine for its disposal; so they pump the tailings through pipes to a dump three miles distant."

"Well, thanks for your information, partner. I'd like to see some of the things you have talked about; but I must be getting on. I am looking up an old prospect I located the year I sold the Eldorado. It seemed promising, and I may make my fortune yet. I think I shall call it 'The Last Chance.'"

28. COAL-MINING

Early coal-mining was confined to the working of outcrops in river valleys, sea-coasts and escarpments. It presented no more difficulties than are encountered in quarrying limestone or in securing sand and gravel from open pits. These surface workings, however, were of limited duration, and the miners were forced to follow the seams of coal into the dark, mysterious interior of the earth. The adit or tunnel was the logical successor to the open pits or quarries.

But as man penetrated the earth to greater depths, new problems presented themselves for solution. He found that he could not follow the seam of coal very far without resorting to some means of supporting the roof of overhanging rocks. He discovered that by leaving portions of the coal untouched the superimposed strata of shale and sandstone received sufficient support to maintain their stability. This practice gave rise to the pillar and stall method of working a coal seam, a method that is still extensively employed. But a lot of good coal remained in these natural pillars, and mine operators in time devised a system whereby they could safely extract all the coal: after a certain area of the workings had been honeycombed by the pillars and stalls, temporary props of timber were inserted while the coal in the pillars was gradually and methodically removed. The props, too, were withdrawn, and the roof of the mine was allowed to settle or fall.

Another difficulty was met and overcome by these early miners. After penetrating a certain distance into the face of the cliff or bank, they found that the air became too foul to breathe: some means of ventilation was a necessity. The obvious method of obtaining a current of fresh air was to sink a shaft at the farther end of their tunnel. Even in places where outcrops of coal occurred on level land and the sinking of pits or deep trenches took the place of tunnels, the gradual dip of the seams would ultimately carry the miners underground, and tunnelling would have to be resorted to, and the same problems of roof-support and ventilation would arise.

In excavating these pits and sinking these shafts other coal seams were sometimes encountered. Much practical knowledge of geology, especially as pertained to the coal measures, resulted from this exploratory work. It became known that coal seams often lie in a series of parallel beds of varying thickness; that coal is found only in rocks of certain formations, and that it differs in kind and quality.

When it came to mining the coal, many other lessons were learned, some at great price. It was found, for instance, that the gases generated in coal mines are always injurious, sometimes deadly poisonous, and often highly explosive, the last quality being often aggravated by the presence of coal dust in the air. Lamps or candles were indispensable to the miners, yet their use led to many fatal explosions. Mine operators, scientists and inventors studied the question from different angles, and tried to devise means of preventing the appalling tragedies associated with coal-mining. It was the inventive genius of Sir Humphry Davy that finally solved the problem. His safety-lamp, a marvel of simplicity, was in time universally adopted, for its use in coal mines was made compulsory.

Coal-mining on an extensive scale began with the birth of modern industrialism. Steam, iron and coal were the three genii that revolutionised the economic and social life of western Europe. Hand in hand they worked to rebuild civilisation, and each has played a vital part in the evolution of our empire.

Another of the problems that confronted the miner, whether of coal or iron, was the effective draining of mines. Pumping of some kind had to be resorted to. It was in an effort to provide the necessary power to operate pumps in mines that the earliest form of steam-engine was put to practical use. Though ineffectual at first, this application of steam-power to industrial purposes was an epoch-making event. It led to that Industrial Revolution in England that changed it from an agricultural to a great manufacturing country.

The use of steam and the building of blast-furnaces for the smelting of iron and other ores gave a new impetus to coal-mining. Geologists made a careful survey of the whole country, and mapped out the coal measures, so that operators could open

up new mines to the best advantage. It was no longer necessary to start their workings at an outcrop. They knew that by sinking a shaft in a certain locality they would strike beds of coal at reasonable depths.

At this stage the primitive or experimental methods of mining were abandoned, and gave place to a technique that is strictly modern and scientific. Of course, many improvements in method have been and are still being made: but the general procedure and practice have been little modified in recent years. We must pass over the intermediate developments of this industry, however interesting they may be, and confine our inquiries to the most improved methods of coal-mining as practised to-day.

In opening a new field, borings are first made at various points in the district to find out the depth and extent of the coal seams. For this purpose diamond drills are employed. The diamond drill, invented by a French engineer, came into general use about fifty years ago. Many valuable deposits have been discovered at great depths by the exploring finger of the diamond drill. This instrument is a rotary drill which cuts out a core of the rock through which it passes. Essentially it is a machine which turns or rotates hollow steel rods, carrying on their extremity a bit, shaped like a ring and carrying a set of drilling points formed of black diamonds. The drill is driven by an engine, using steam, gasoline or electric power. These engines range in size from eight to eighty horse-power. The drill-pipe is fed through a modified form of the hydraulic jack, mounted over the hole that is being bored. The driller can operate the hydraulic jack independently of the engine that drives the drill, varying the pressure to suit the nature of the rock through which, or the depth at which, he is boring.

The pipe used in diamond-drilling has flush joints so as to offer as little resistance as possible. It is made from seamless steel tubing, having a great tensile strength for its weight. Inside the drill-pipe work the core barrels, these being tubes of the same diameter as the bit. The core barrels, from one to eight inches in diameter, retain the core of rock until it is withdrawn from the hole.

In drilling for coal a special "floating" core barrel is used. It consists of an inner and an outer tube, the one next the core resting on ball-bearings, in order that it may rotate freely and independently of the outer tube. This method prevents the grinding or wearing away of the soft core of coal.

The cutting of the rock is done by the diamond-pointed bit. It requires a special kind of steel or iron for these bits. The bit must be soft enough for the diamond-setter to cut it and yet so hard that it will stand up under the wear to which it is exposed. The black diamonds used in this work come from Brazil and must be broken into fragments before they can be used. For setting an eight-inch bit the diamonds cost from five to eight thousand dollars.

Having ascertained by borings the exact location and character of the seams of coal that he is to work, the mine operator next decides upon the most advantageous points at which to sink the shafts. The shape, kind and size of shaft will depend upon the nature of the strata through which it passes, and the extent of the proposed underground workings. Round shafts are customary in some countries, rectangular or polygonal in others. In Canada the rectangular form is preferred.

The shaft is lined with wood, brick, concrete or iron "tubbing." There are never less than two shafts to a coal mine. The main or "downcast" shaft, through which the fresh air is drawn or forced into the mine by means of one or more fans, and up which the coal is conveyed in "skips" or tram-cars, is divided into two or more sections by brattices or partitions. At the bankhead or surface end of the shaft is a substantial steel structure, usually encased with corrugated iron, provided with means of dumping the skips for cars, and with screens and conveyors for grading and loading the coal.

The pits or shafts are usually sunk near the centre of the area covered by the bed which it is intended to work. In certain localities, of course, this is impossible, especially where the seams extend under the sea, as many of them do in Nova Scotia and British Columbia. In seams of five feet in thickness or over, the pillar and stall system is generally used: in seams under five feet in thickness, the longwall system is often

employed. By the latter method the coal is "won" or obtained by taking it off in long faces, leaving no pillars except near the shafts and main roadways, and allowing the roof to settle gradually as the coal is removed. When the pillar and stall system is used, the size of the pillars will depend upon the sustaining strength of the coal and the nature of the superimposed strata. In submarine workings the thickness of the pillars depends upon the thickness of the covering above the seam. When the boundaries of a mine have been reached the coal in the pillars is usually recovered, beginning at the outside limits and retreating towards the main shaft. It is not considered safe to remove the pillars from submarine workings.

Coal is mined either by hand or by machines. In modern collieries machines are in general use. When the former method is resorted to, miners, usually working in pairs, undercut the face of their stall and nick it down on each side with their picks. Men called shooters then bore three holes in the coal face, one in the centre and one on either side near the top, the holes slanting upward, and shoot down the coal with charges of monobel, an explosive specially adapted for use in coal mines. Coal-cutting machines are usually operated by compressed air or electric power. They have replaced hand-work in most mines. The broken coal is shovelled or forked into skips or dump-cars, which are then drawn by horses to the main deeps, along which trolley lines lead to the shaft. In some mines compressed-air locomotives are employed to deliver the loaded cars to the shaft.

In some mines the coal is weighed at the bottom of the shaft, where two inclined chutes lead to the two hoisting compartments of the shaft. Here two hoisting tanks receive the coal. These tanks, each of eight-ton capacity, are hoisted to the dumping level, where they are automatically discharged into fifty-ton hoppers. From the hopper the coal passes to sets of shaking-screens by means of belt conveyors. The first screens are of two-inch aperture. The coal that passes through these is then conveyed by belts to screens of three-quarter-inch aperture. The material that passes through these latter screens is known as slack; what remains is known as nut coal.

THE TRAIL SMELTER

29. THE TRAIL SMELTER

(Prepared and Written by the Grade VIII. Pupils of the Trail Tadanac Public Schools)

Thirty Years Ago

By Alice Hopkins

Trail is a small but very important city, situated on the banks of the beautiful Columbia River. This river wends its way through the town, but is very swift and not safe for navigation. Trail is surrounded by the Selkirk and Gold Range Mountains. Many people wonder how Trail got its name, but that is very simple. One day some men came sailing up the Columbia River. They landed on its timber-covered shores and, having heard of the discovery of gold in the hills farther up, they cut

a trail through the beautiful forest and went on their way up to Rossland, leaving the trail behind. Our city has been called "Trail" ever since. As it was more level at Trail, they decided to bring the gold and copper ore down and smelt it here. They cleared away some of the bush and huge trees, and built a few small cabins. That was in 1894, but now what a difference! If some old-timer were to come back, what a surprise he would get! I'm sure, too, he would be proud of it.

Trail did not have any railways then. Pack-horses were used to carry the gold and ore.

The men decided to build the smelter, which now covers three hundred acres, on a hill called Tadanac. Tadanac, if you notice, is Canada spelt backwards with a "T" added to stand for Trail.

Later, the small rude cabins were replaced by nicely painted houses. The skating-rink, the bridge and the school were built.

People who have not been to Trail imagine it is a terribly smoky place, but I am sure if they did visit it they would change their minds.

We have very pleasant winters here. Skating is one of our chief winter sports, and we have plenty of sleigh-riding. In the summer we go swimming across the river at a place called Sandy Island, and as the sun is lovely and warm we do not get cold.

How Prosperity Came

By Renie Balfour

With the depletion of the Rossland ores the attention of the company was turned to the Sullivan mines. These mines were rich in lead and zinc ore, but no way that would be profitable could be found to separate the lead from the zinc. The engineers saw that, if some better method was not found, Canada would lose a great industry, and for four or five years they made great efforts to get this one process. They then presented a plan which they thought would work, but it would cost over a million dollars to finance. Now the Great War started and Canada needed metals. The Government offered to help build

this new plant, and loaned what money was needed. The plant was built, and from that day the prosperity of the smelter was assured. After the war, almost all other places in British Columbia had no work, and hundreds of people found their way here.

The smelter has extended almost half as far again as it was before the war. The copper rod mill—the only one of its kind in Canada—has been built. A new zinc plant has been recently put up and is now working. The smelter has its own foundry, and now they are able to make and cast most of their own machinery.

Trail as a whole has grown immensely. Where there were three or four houses, now there are hundreds, and they are still going up as fast as ever. Before the war the buildings were of wood, and now they are replacing them by brick and stucco structures. The population has increased to over six thousand, almost twice as much as it was before the war. The smelter alone employs over two thousand men.

The Big Smelter

By Shirley Wilson

The largest non-ferrous reduction works in the world are situated at Trail, a few miles above the international boundary. The plant is built on a plateau above the city, which lies along a gulch and widens out towards the river.

This smelter is never still; it goes day and night, and if the furnaces ever went out with metal in them it would cost thousands of dollars to have them repaired, because they would have to be torn down and reconstructed.

The reason for the prosperity of this plant is the invention of a new zinc process. Ore is obtained from numerous mines throughout British Columbia, but the biggest ore-producer is the Sullivan mine at Kimberley, where there is sufficient ore to keep this great smelter going for fifty years. Only a small amount of ore now comes from Rossland, the smelter having been nevertheless erected at first to treat the Rossland ores of gold and copper.

Electrical Wonders

By Heber Ollis

The electricity needed for Trail and the smelter is generated at Bonnington Falls, on the Kootenay River. The "juice" is generated by big dynamos or magnetos. These are run by big water-wheels with iron vanes placed so that the water will hit against them and force the wheel around. The generators are very big, and one of the biggest weighs one hundred tons. This one is in the new generator plant which has just been opened. They are used for sending the "juice" through the wires over to us.

The current is used for refining the metals, running motors, blowing furnaces, extracting lead and zinc from the smoke, grinding machines and riveting, running ore trains, heating, lighting and cooking, and even the barber uses it to run the clippers with which he cuts your hair, and the ice-cream man uses it to mix the ice-cream drinks for us.

The Big Stack

By Kitty Martindale

The large stack, made by workmen brought from Pittsburg, U.S.A., is four hundred and nine feet in height. The base is thirty-one feet in diameter, and the walls three feet wide. The top is twenty-one feet in diameter inside.

The higher the stack gets in construction the higher the workmen's wages get, because of the dangerous nature of the work. Often the men become dizzy and have to be carried down.

The structure, made of cement, is lined with brick, having lightning conductors running up the exterior and at the top. About four hundred thousand cubic feet of gas goes up the stack each minute.

Where the Lead Sinker on Your Fishing-Rod Came From

By Frances Dockerill

Most of the lead ore in the Trail smelter comes from the Sullivan mines in Kimberley. It is fed to the furnaces in charges, which are composed of ore and flux, mixed to make a proper smelting material. To keep up the proper heat a strong current of air is driven into the furnace. When the ore is melted, the metal, being the heaviest, sinks to the bottom, and the waste rock, called slag, rises to the top and is allowed to flow on to the slag dumps.

The metal, containing mostly lead and some silver and gold, is tapped out of the furnace and taken to the drossing plant. Here it is cast into moulds and takes the form of an anode. The anodes are loaded on to cars and hauled to the refinery by electric motors. On arriving at the refinery, they are lifted up by a crane and placed in tanks, where the lead is refined by what is known as the electrolytic process. Between each two anodes is placed a cathode, which is a sheet of lead hung on a copper bar. The tanks are filled with a liquid called an electrolyte, which must be kept flowing through the tanks. The tanks also have an electric current flowing through them. By this process the lead in the anode is dissolved and deposited on the cathode. The lead, after being washed, is melted in large pots and pumped into moulds ready for shipment.

The lead is shipped from Trail to China, Japan, and some of the countries of Europe.

The silver and gold from the anode is left in the form of black slime. This is taken to the silver refinery. The remainder of the anode is melted over again. The thin lead sheets, called cathodes, are made by pouring melted lead over an iron plate.

Three hundred and seventy-five tons of this metal are now being produced every day.

Melting Copper

By Alex Gripich

The copper-melting plant is situated at the extreme right of the Trail smelter. This plant turns out and ships from thirty to forty tons of pure copper daily. Although this building is important it is not large, and is littered with tools and other things in apparent confusion.

The first thing that meets the eye of the stranger entering the plant is a huge furnace right in the middle of it. On the other side is another furnace, furnishing steam needed to heat the copper electrolyte. The copper sheets, which are taken from the refining tanks, are put into the large furnace and melted down. This takes about twelve hours to do. Below the large furnace is a well about twenty-five feet in diameter, and in this well is a round table about eighteen feet in diameter and about three feet off the ground. On the edge of this table are steel moulds, which can be changed to any size.

After the copper has melted down, the table is made to revolve slowly, while out of the furnace pours a stream of molten copper. This flows into the moulds as they pass by. A little farther on is a man who scrapes off the refuse on the molten copper and then turns the moulds over and into a trough of water, where they cool. Out of this trough comes an endless steel belt with steel cross-pieces at intervals. As the belt comes out of the water there is a block of copper resting on the cross-piece. The copper is lifted on to a steel platform, from which it is carted to the door of the building and loaded into cars for shipment to the consumer.

What is Zinc?

By Catherine Stimmel

Zinc was discovered by the Romans in ancient times, but they did not have it separated from the copper. They found rocks in the earth which, when melted, produced a mixture of

copper and zinc called brass. It was not till the sixteenth century that zinc was separated from other metals. Zinc is a silver-grey metal, and when broken shows a very shiny surface. It is not as hard as iron and it does not rust as iron does, but lasts a long time.

It is refined from its ores by two methods. One method is by heating the zinc ore in a furnace. The zinc comes off as steam does from water, and it condenses as steam does. This method is the first known method, and has been used since it was discovered centuries ago. The first countries to produce zinc in this way were Germany and Belgium.

In the last few years a second way to make zinc, by the use of chemicals and electric current, was discovered. Big plants for refining zinc by this method have only been working the last ten years. This is the way zinc is refined at Trail.

Zinc is used in making brass for ornaments and parts of machinery, and it is used to cover iron by dipping the iron in molten zinc. It is also used in making paint. One of the chief advantages of zinc is that it will not rust.

The Zinc Process

By Betty Newell

The Consolidated Mining and Smelting Company depends almost entirely on the ore from the Sullivan mine, Kimberley, to supply the zinc plant. The process for making zinc at Trail requires that the zinc ore be in the oxide or sulphate form, so that the zinc will be soluble in sulphuric acid. Sulphide zinc is therefore roasted in wedge roasters at a temperature of about 1170 to 1260 degrees Fahrenheit. The roasted ore is treated by an acid solution in two stages, known as the "neutral leach" and the "acid leach." All the roasted ore is first treated in the neutral leach, and then the pulp is thickened and treated in the acid leach.

The solution is then treated by electricity, the zinc being deposited on aluminium cathodes and an equal amount of sulphuric acid liberated at the anode.

The deposited zinc is stripped off the aluminium cathodes, melted in a furnace, and cast into fifty-pound slabs for shipment.

Two hundred tons of refined zinc are being produced every day at present.

From Black Slime to Beautiful Silver

By John Hollington

The silver refinery is situated on the top of the right bank of the Columbia River. There are bars on the doors to prevent anything from being stolen.

The gold and silver slimes from the lead and copper refining tanks are taken to the silver refinery to be dried, after which they are put into furnaces, where they are melted down into a metal containing silver, gold and antimony, lead, copper and arsenic. This molten mass is subjected to a great heat until there is nothing left except gold and silver, which is in the form of an alloy called Dore metal. This Dore metal is then cast into bars and boiled in sulphuric acid until the silver is dissolved. As the gold will not dissolve in this acid it settles to the bottom. The silver solution is siphoned off and, when cooled, it is put into large tanks where copper plates are hung. These plates attract the silver from the solution in the tank, and the silver falls to the bottom as a white powder. This is melted into pure silver bars, which are from ·9994 to ·9998 per cent pure silver.

A great deal of this silver is shipped to the Orient.

30. PORTLAND CEMENT AND ITS USES

Portland cement enters very largely into modern construction work of all kinds: including the piers and foundations of bridges; the erection of all classes of buildings, from simple bungalows to towering skyscrapers; the surfacing of roads and pavements; and the structure of docks, dams, reservoirs and aqueducts. Its universal use is owing not only to its intrinsic usefulness, but also to the wide distribution of the raw

materials out of which it is made. These materials, limestone, shale, clay and gypsum, are to be found in most of our provinces; but Quebec, Ontario and British Columbia, in the order named, are at present the chief producers of Portland cement.

Though the ingredients used in making Portland cement are of common occurrence, the process of manufacture is far from simple, and involves the expenditure of much capital. The mixture of limestone and shale is quarried in the usual way, by means of air-drills and steam-shovels. It is conveyed to powerful gyratory crushers, that reduce the rock to fragments of fairly uniform size. Separate bins receive the crushed limestone and shale. From these bins the material passes to a series of ball-mills, rotated by means of motors. A certain amount of water may be added at this point, and the mixture passes to separators, from which the oversize pieces are returned to the ball-mills, while the bulk of the crushed rock is conveyed into tube mills, often six feet in diameter and twenty-two feet long, where the crushing is completed. The mixing is sometimes done at this point, and water added when the material passes into the slurry-mixers. From these the liquid mass is pumped into a series of open vats or tanks, arranged at different levels so that the liquid can flow from one to another. Huge paddles stir the substance in the tanks, and hourly tests of the contents of each vat are made in the laboratory operated in connection with the plant. By means of the tanks the proportion of the ingredients in the slurry can be regulated.

When the mixture is exactly right it is pumped to the drying kilns. Each kiln is a horizontal steel cylinder, lined inside with firebrick, and rotated slowly on its long axis by means of a motor. One end of the cylinder communicates with a concrete chimney about a hundred feet high: at the other end is a jet of flame, devouring finely powdered coal and producing a temperature of 2700 degrees Fahrenheit. The liquid containing the limestone and shale flows through the cylinder from the chimney towards the flame, losing its water content as it advances. By the time it reaches the fire it has been reduced to a solid clinker. Other cylinders, known as rotary coolers, receive the clinker and pass it on into storage-bins.

The next process is the grinding of the clinker. But before this is done the clinker is supplied with a certain amount of gypsum. The mixture is conveyed to another series of ball-mills, in which it is thoroughly ground. At this point steam is introduced in order to slack any particles of lime that have escaped complete hydration. Tube-mills finish the pulverising of the cement and pass it on to a series of cooler mills, from which it goes by screw-conveyors to storage-bins of large capacity. The cement is now in such a finely powdered condition that 90 per cent of it would pass through a sieve having forty thousand openings to the square inch. But it may contain a few extraneous articles, such as nails and bolts, so it is carried aloft by conveyors and dropped on to screens. The cement is fed by screw-conveyors to the automatic packing and weighing machines. Barrels or sacks are used as containers. A sack is supposed to contain ninety-four pounds, and four sacks make a barrel.

Portland cement, before being used in any important structural work, should be carefully tested. If it contains hard lumps it should be rejected without further examination, as this indicates that chemical action has set in. Other appearances are not to be relied upon, and samples should be submitted to crucial tests, for the making of which standard appliances and formulæ are available.

The term *hydraulic* is applied to cement that possesses the property of *setting* or becoming hard under water. Portland cement, because of its superior qualities in this respect, is often known as hydraulic cement; but it is suitable for any class of construction work, whether under water or exposed to the air.

Concrete is made of cement, sand and crushed rock, in varying proportions according to the pressure or strain under which it is likely to be placed. The size of the broken stone is determined by the nature of the concrete construction; for foundation and other massive work, stone that will pass through a ring two inches or two and a half inches in diameter, is used; for reinforced concrete construction, the size of stone is much smaller, varying from one-quarter of an inch to an inch in diameter. The nature of the stone and the quality of the sand are also of importance: the stone should, if possible, be trap-rock or granite,

and the sand must be free from earth or other impurities. The spaces or voids between the stones must be completely filled with mortar. When the stones are of different sizes, they help to fill up the voids and thus effect a saving of cement. For foundation work, cement, sand and broken stone are used in the proportions of one, three and six; but in the piers of bridges, in dams and reinforced concrete work, proportions of one, two and four are considered advisable. In mixing concrete it is important to use the amount of water necessary to bring the cement in close contact with the sand and stone; but more than this will weaken the concrete.

When small quantities are required, concrete is mixed by hand; but on extensive work machines are used for this purpose. In the former case, the proper amount of sand is spread out evenly on the mixing-board, cement is added, and the two ingredients are mixed by turning them over with shovels. The broken stone or gravel is wetted before incorporating it with the other ingredients, and water is added after each turning, until the whole mixture is of the consistency of porridge.

Concrete should not be laid in freezing weather, and at any time no more should be mixed than can be immediately used. In hot weather, frequent wetting-down of concrete work is necessary until it has thoroughly set; and it should not be subjected to any undue strain or pressure for a considerable time after it is laid.

The reinforcing of concrete by means of steel rods, bars, beams, hoops and screens is a comparatively modern practice, but has had a far-reaching effect on all kinds of structural work. The combination of steel and concrete permits of higher, lighter and stronger structures at less cost than in the brick-and-stone construction of early days. It is of especial value in the erection of fireproof buildings, the component parts of concrete being of a highly refractory nature. The use of concrete in road construction, either alone or as a foundation for asphalt surfacing or wood-block paving, has been a most important factor in solving our highway problems, which became so urgent during the last two decades owing to the phenomenal growth of motor traffic.

31. THE WOODEN WALLS OF CANADA

When the first settlers came to the shores of America, they were confronted by the solid wall of forest stretching along the seaboard from Labrador to Florida. Side by side, in orderly ranks, stood the stately pines, the graceful cedars and the stalwart maples. Perhaps these sylvan sentinels waved their branches in lordly disdain as the pygmy pilgrims from across the seas sought shelter under their boughs. Or did a shudder of fear, a premonition of the fate that awaited their race, pass up those majestic trunks and cause every leaf to quiver?

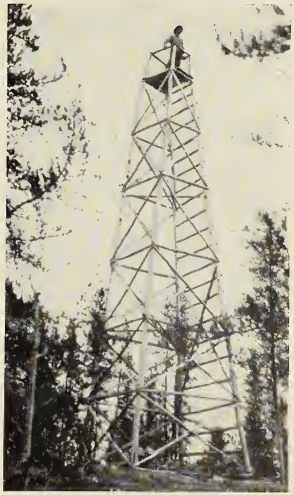
Department of the Interior

A FOREST FIRE

There were some weak-hearted men among the early adventurers. They were appalled at the magnitude of the task that lay before them: to push back that solid wall of forest and carve homes for themselves in this wilderness. But many had "hearts of oak" as stout as the hearts of the pine, the beech and the maple they had to subdue. They set to work and began pushing back that serried wall of living spears. They never ceased pushing, hewing, slashing and burning, they and their descendants, even unto the present day.

For many years the forests had no partisan among the hordes that assailed them but the poet who exclaimed, "Wood-

man, spare that tree!" Poets, however, had little influence, and the woodman did not listen. The wooden walls of Canada were pushed farther and farther back. Unlike the Tommies who form the British square, the trees could not close ranks as their comrades fell, and many a lonely warrior was left standing in solemn but pathetic grandeur, to chant weird requiems over the slain battalions that lay about him.



Department of the Interior

FIRE RANGER'S LOOK OUT

How high would you estimate the look out is? What kind of trees surround it?

At first the pioneers were merely concerned with this process of hacking through the wooden walls that held them back or hemmed them in. But there came a time when a new motive actuated them. They discovered that pines could be minted into pine-tree shillings. The settler was no longer contented to hew out a small clearing in which he could build his cabin and plant his corn and potatoes. His winters were now spent in felling white pine, cutting the huge columns into logs and hauling these to the rivers, down which he would drive them in the spring to be devoured by the insatiable maws of the mills. Lumbering as an industry had begun in Canada.

Man, with all his book-knowledge, is in many ways a blind, ignorant, restless, acquisitive creature. It took him two centuries to learn how essential to his well-being, his very existence, are the protective walls of the forest. To-day he realises it dimly, almost subconsciously. Not only the poet now cries, "Woodman, spare that tree!" It is broadcast throughout the land as a national slogan.

Do not let us deceive ourselves, however. Men cry out against destruction of the forests for very selfish reasons. They

know that not only the future but the present health, wealth, and prosperity of the Canadian people are inseparably connected with preservation of her wooden walls. That is why our statesmen, both provincial and federal, have shown such an interest in forest protection and conservation. They realise that destruction of our forests means ruin to the life of the nation. Therefore they are sparing no expense in carrying out a campaign of public enlightenment. They fight actively on the side of the forests against the reckless and selfish exploitation of our timber resources by unscrupulous profiteers, the criminal proclivities of the incendiary, the ignorance or indifference of the camper and tourist. They set in motion such machinery as will ensure the perpetuation of our second greatest natural resource, the pitiful remnant of that mighty forest, those wooden walls, that once stretched in an unbroken semicircle from sea to sea.

Let us see if we have a clear understanding of the great national needs that have at last stirred our politicians into action. Perhaps an enumeration of the points set out in a proclamation issued by His Excellency the Governor-General, regarding the importance of our forests to the Canadian people, will throw some light on the subject:

1. The Forest, next to agriculture, is the greatest source of national income.
2. The Forest can with care and proper handling contribute permanently to the welfare of the nation as well as to the health and happiness of its citizens.
3. The Forest supplies not only the raw material for our industries, but also, in the form of the woodlot, provides fuel and other useful products for the farm.
4. The Forest, planted on sand areas, stops the invasion of good farm-lands by blowsand, and at the same time reclaims to the service of man waste areas now serving no useful purpose.
5. The Forest, planted as shelter belts on the open prairie, protects stock, makes fruit-growing possible, and beautifies the home.
6. The Forest conserves the water in lakes and rivers,

thereby protecting the fish and game and ensuring constant stream-flow, so necessary in water-power developments.

7. The Forest is the greatest single attraction to the tourists who visit our country.
8. The Forest is the main source of supply of softwood timber within the Empire, and should be protected by every possible means.

This proclamation goes on to state the dangers which threaten our forests, and the means which the Government proposes to take in order to combat them:

1. Almost universal carelessness with fire in the forest, resulting in the destruction not only of timber and young growth, but of the very soil which produces it.
2. The use of wasteful and destructive cutting methods without any thought of ensuring a new crop.

The remedies which the Government proposes to apply are three:

1. Woodlot conservation, waste-land reclamation, and shelter-belt planting will be more efficiently carried on.
2. Woods operations will be so conducted as to provide the best conditions for regrowth of valuable species of timber.
3. Proper precautions against fire in the forest will be demanded of all, and carelessness or neglect will involve the fixing of responsibility on the individual and the application of the penalties provided by law.

The facts set forth in this proclamation, issued in April 1927, will doubtless be applicable to prevailing conditions for many years to come. We may to advantage enlarge upon some of the points mentioned, using them as the basis for a survey of the forest problems that at present confront the people of Canada.

In what way does this country derive an income from the forests? The public exchequer is annually enriched by the dues, stumpages, royalties and income taxes derived directly or indirectly from the exploitation of our forests. This applies to the provincial as well as to the federal revenues. The

capitalists who have their money invested in saw-mills, pulp-mills, shingle-mills and timber limits, derive the greatest benefit from this natural resource. Others who receive direct rewards are the thousands of men who are employed in the woods, getting out timber or pulpwood, and those operating the mills or conveying forest products from woods to mill, from mill to market, and from market to consumer. But in addition to these are the great body of Canadian citizens, who directly or indirectly share in the wealth which our forests yield.

In connection with woodlots, it is of interest to note that, in the province of Quebec alone, over four million dollars a year comes into the pockets of the farmers from the sale of maple sugar and maple syrup. When the farmer wants a new axe-handle, shafts for his sleigh, a few fence-rails, or his winter's supply of fuel, he draws on the resources of his woodlot. Needless to say, unless some system of replanting is adopted, the woodlot will dwindle in size until it ultimately disappears. As a nesting-place for our insectivorous birds, the woodlot is not only a boon to the farmer who owns it, but an asset to the country at large.

The planting of trees for the purpose of reclaiming sandy wastes and preventing adjacent lands from being inundated by blowsand, is a good example of constructive forestry. As a corollary to this we should learn the importance of preserving our natural forests, as by their removal we are likely to convert areas at present productive into wind-swept wastes. This has been the sequel to forest destruction in other lands, and our country is subject to the same inexorable laws of Nature. In Saskatchewan, Government nurseries at Indian Head and Sutherland supply seedlings of suitable trees to citizens who are willing to pay the freight on them. In the month of May 1925 nearly five millions of these seedlings were distributed and planted in woodlots, or as hedges, shade-trees and wind-breaks.

Now that our water-powers are being developed so extensively, the constancy of stream-flow is of vital moment to many industries, as well as to the health, comfort and convenience of the inhabitants of our cities and towns. The forests conserve

the water-supply and regulate its delivery into rivers and lakes, thereby preventing both floods and droughts.

Of the thousands of tourists who visit our Northland every summer, it is safe to say that few would be attracted a second time to a district that has been devastated by fire or laid waste by the logger. Our winter sports, too, so intimately connected with the woods, are attracting an ever-increasing body of tourists. The big game, for which Canada is famous the world over, are vitally dependent upon the preservation of large areas of virgin timber. The Government is to be highly commended for its policy in setting aside so many and such large areas of wilderness as national parks and forest reserves.

Canada has come into first place as a producer of news-print. If she is to maintain her lead in competition with countries like Norway, that pursue a sound policy of forest conservation, she must not only protect her present timber areas, but must provide by reafforestation for their perpetual maintenance.

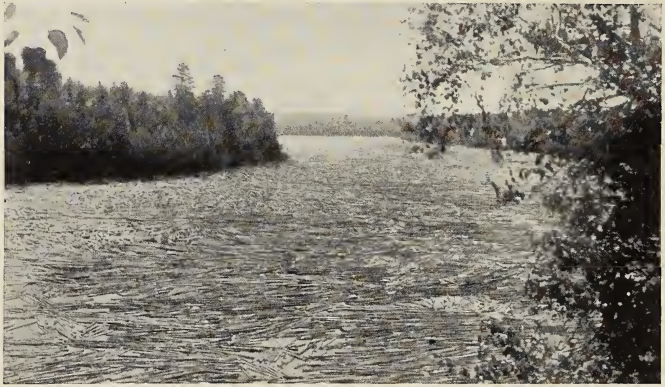
32. LUMBERING IN EASTERN CANADA

In early days, the next thing in point of excitement to the arrival of a circus was the spring drive. The more venturesome lads used to go miles up the river to visit the temporary camps of the shanty-men or river-drivers, those red-shirted, top-booted, bearded heroes of the north woods, who rode and drove the tossing, tumbling, milling herd of logs that represented their winter's cut, down foaming rapids, over noisy shallows and thundering falls, to the dark, foam-flecked lower reaches near the river's mouth, where a round-up of each company's logs was made before they found their way to the waiting jaws of the mills.

"The river-drivers are coming!" was a slogan that set many hearts beating; for nearly every home along the water-front awaited the coming of father, son or brother, who had toiled in the backwoods all winter. The school registers showed significant blanks in the attendance column when the drive

was on; for the lure of the lumber-camps proved irresistible to adventurous youth. How proud was the boy who could point to a stalwart lumberjack, wielding a pike-pole as lightly as an ordinary man twiddles a cane, and say: "There is my Pa! Look at him spin that log!"

Then there was the visit to the night-camp, the appetising odours of fried pork, mingled with the strangling fumes of *habitant* tobacco. In the cook's shanty was the inevitable pot of bear's grease, a sovereign cure for rheumatism and wrinkled



Department of the Interior

A RIVER OF LOGS

boots. The boy who succeeded in wheedling the cook out of a tin of this grease straightway put on the airs of an Æsculapius, and succeeded in effecting marvellous cures among his less fortunate comrades who had suddenly been smitten with mysterious rheumatic pains.

The romance and glamour of the lumber-camps departed with the bitter feuds that used to exist between the crews of rival operators. Competition has given place to co-operation. Gangs that formerly would have fought on sight, now pool their man-power in the difficult and dangerous work of driving logs; and lumber companies share jointly in the expense of building dams, clearing streams and opening roads. This

change is, perhaps, more noticeable in Ontario than in the wilder regions of northern Quebec and central New Brunswick, where traditional conditions and practices largely prevail.

Winter is the season for cutting the timber and hauling the logs out of the woods. The comparatively small size of the timber, the deep snows, and the frozen lakes and rivers, render the use of railways unnecessary and unprofitable, except in certain localities. After the logs are cut they are loaded on sleighs and hauled to the bank of the nearest stream, whose flood-waters will be capable of floating them on to the shores of a lake.

The operator brands the end of each log with the registered trade-mark of the lumber company for whom he is working, so that when the river-drivers from a number of camps have co-operated in conducting the drive to a common booming-ground, the logs may be separated according to their various brands, and rafted to the mills. The drive itself often calls for consummate skill, strength and courage on the part of the men. At bends and shallows in the river jambs often form, damming up the waters and piling up the logs in what appears to be an inextricable mass. But men skilled in the work will unhesitatingly mount the jamb, and with peavies, pike-poles or dynamite loosen the key-logs. Such operations sometimes result in fatalities, but as a rule the men return to shore or ride the logs through in safety.

Though lumbering has been a leading industry in eastern Canada, from Nova Scotia to Ontario, for over a hundred years, the forests in these provinces still carry immense stands of merchantable timber. Fifty-four per cent of the land area of Nova Scotia bears some form of forest growth; and approximately 70 per cent, if we include the *brûlés* and barrens, may be rated as suitable for forest production. The fact that the forests of Nova Scotia still give shelter to such big game as bear and moose, gives us some idea of their extent and wildness.

Entering these forests, whose fringes were first sighted and perhaps entered by the Cabots, and which first contributed to the needs of civilised man by supplying timber for the building of Port Royal, let us see of what trees they are composed.

The nature of the stand will depend upon the nature of the soil and the underlying rocks. In large areas we see chiefly conifers: in favoured districts or scattered patches, hardwoods abound.

The principal conifers are the spruces and pines. Red spruce, towering to a height of eighty to a hundred feet, is the most important lumber tree of the province. The white spruce, so valuable as a pulp species, is less abundant. In favourable situations it will attain a trunk diameter of three to four feet and a height of a hundred and fifty feet; but no trees of this size seem to have escaped the axe of the lumberman. The remaining species of this genus is the black spruce, whose wood is largely used for timbering the coal mines of Nova Scotia. It is also much in demand for railway ties and pulpwood.

Lords of the Acadian forest, towering in ancient days to a height of nearly two hundred feet, are the white pines, whose wood serves more useful purposes than that of any other native tree. At present we see few of the stately trees that delighted the eye of the poet or aroused the cupidity of the lumberman. Little but second growth can be seen; but under the fostering care of a far-sighted Government, the grandeur and beauty of the ancient forest may be restored. Red pine—used extensively for the masts, spars and planking of ships, and in car-construction—balsam, hemlock, cedar and larch, are the remaining conifers that contribute to the timber wealth of the province.

Of the hardwoods—beech, maple, birch, oak and ash—each has its special uses. The most valuable is the yellow birch, much in demand for the manufacture of flooring, furniture and cars. Poplar is widely distributed, being one of the first trees to appear in *brûlés*. Its wood is used for pulp, excelsior, boxes and matches.

When we cross the Bay of Fundy and enter the forests of New Brunswick, we see little change in the sylvan flora as regards species of trees. The same dominant types prevail. Black and white spruce, balsam fir and cedar are the chief conifers: white and yellow birch, maple, beech and poplar, are the main deciduous species. But what we do notice is the

vaster areas of the stands, the unbroken continuity of the forest growth. The Crown lands alone comprise an area of 7,500,000 acres, of which two-thirds is practically untouched by the hand of man. Moose, deer and bear find shelter in these solitudes, making New Brunswick one of the finest big-game preserves on the continent. Wise Government regulations and their strict enforcement are largely responsible for the conservation of forest wealth in this province.

Because the hardwoods are not so easily logged as the softwoods, they have been systematically shunned by the lumbermen of eastern Canada. The stands, therefore, have remained practically untouched, and now form a very valuable asset. The demand for hardwood is increasing to such an extent that the high price offers sufficient inducement to the modern lumberman to engage in this branch of logging. As the specific gravity of hardwoods, generally over forty pounds to the cubic foot, makes it difficult or impossible to float them down the rivers, they must be shipped to the mills by rail. Creosoted hardwood is now being used for railway ties; maple, birch and beech in large quantities are required for the manufacture of lasts, furniture and flooring, and in the production of wood alcohol, acetic acid, acetone and charcoal.

The forests of Quebec have been actively exploited by the lumberman for over a hundred years, and yet at the present time the province contains an area of 130,000,000 acres of merchantable timber. Merging into the barren tundras of Ungava is the Sub-Arctic Region, carrying scattered stands of spruce, balsam, tamarack, poplar and birch that will ultimately be utilised for pulpwood and other purposes. Only one-sixth of this vast area bears timber of merchantable size.

The Laurentian Region is the principal scene of lumbering operations to-day, as it has been since the inception of the industry. The area comprises 75,000,000 acres, carrying, in addition to the species already mentioned, pine, cedar, maple, ash, elm and basswood. The original stands of pine, as in the Maritimes, have largely disappeared; but second growth of fair size occurs. White spruce is in great demand by the many pulp-mills in the province, and the supplies of this timber

are being rapidly absorbed. In the logged-over areas, hardwoods predominate, having been left untouched by the early lumbermen. Their value and importance are steadily increasing as new industries, handling hardwood products, are established. The Gatineau and other tributaries of the Ottawa have vied with their sister streams on the Ontario side in pouring their forest wealth into the mills of the St. Lawrence Valley.

The St. Lawrence plain was originally heavily timbered with the very finest stands of red and white pine. But the fertile land was required for purposes of settlement and agriculture; so the present forest, composed largely of scattered stands of hardwoods, intermixed with conifers, occupies the impoverished sandy soils of the district.

The remaining forests of Quebec are those of the Allegheny Region. They clothe the slopes of the Notre Dame and Shickshock Mountains, extending from the Eastern Townships to Gaspé. In this area of twenty million acres, red spruce and balsam fir form about 60 per cent of the stand. Lumbermen find the district difficult to work, on account of its rugged surface and the lack of suitable streams for the driving of logs.

33. LUMBERING IN BRITISH COLUMBIA

LUMBERMEN from eastern Canada who started the logging industry on the Pacific Coast were obliged to modify their methods, to suit the size of trees they had to handle. A tree eight to ten feet in diameter and two to three hundred feet high, presented difficulties to men accustomed to the comparatively small timber of Ontario, Quebec, or the Maritimes.

There was first the task of bringing the giant conifer to the ground. Even the most skilled axemen might hesitate to pit their strength against its monstrous girth. The long cross-cut saw first helped to solve the problem. But the trunk near the ground spread out to undue proportions: so, to make their work easier, the fallers devised the spring-board. Notches were cut in the base of the trunk at various heights, and pieces of squared

timber were driven into them. On these spring-boards the fallers stood while they wielded axe and saw, several tiers of boards being sometimes required to bring the men to the desired height. The stumps that were left were often ten feet high, representing a loss of over five hundred cubic feet, or about four thousand feet, board measure, in every tree cut. But in those days no regard whatever was paid to the waste entailed in logging operations.

After putting in an undercut with their double-bitted axes, the fallers transferred their spring-boards to the other side of the tree and put in a parallel cut a little higher up with the cross-cut saw. To prevent the saw from binding and to ensure the falling of the tree in the right direction, wedges were driven in behind the saw. As the tree approached its fall, these wedges were driven home, and the cry of "Timber!" rang through the forest, warning all men in the vicinity to stand clear.

When the giant fir was down, the buckers fell to and cut the prostrate trunk into logs of standard length. But in those days their sawing ceased at the first limbs: everything above was left to cumber the ground and form a breeding-place for bark-beetles and borers.

The next problem was to get these huge logs into the water. By water, in this case, we mean the "salt-chuck," or sea. No use to roll them into a river and drive them in the eastern fashion; for one of these logs was capable of blocking an ordinary stream. They must be hauled to the sea-coast: but how? There was no snow worth speaking of on the western slopes of the coast mountains, and even if there had been, no sleigh could be built strong enough to bear such a weight. An effective system was soon adopted. Skid-roads were built on easy gradients, leading from the site of logging operations to the sea. These roads, remains of which can still be seen in the woods, were made of small logs, laid crosswise like railway ties, but farther apart and half embedded in the ground. The men who were employed in the construction of such roads were known as swampers.

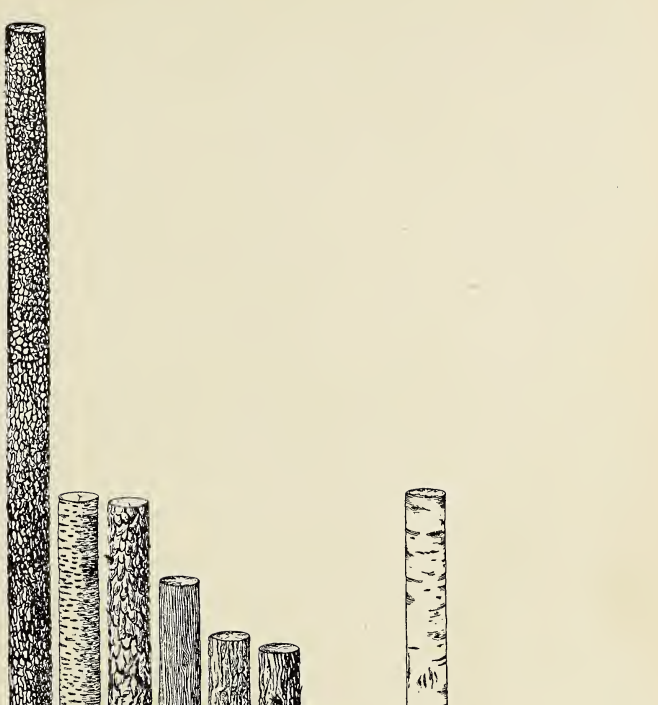
To prevent the logs from ploughing up the skids, and to pass obstructions, their front ends were bevelled at the edge.

A "dog," attached to the end of a stout chain, was driven into the log by the hook-tender, and a team consisting of six or seven span of oxen, under the expert direction of a "bull-puncher," hauled it away to the head of a chute situated near the booming-ground. To reduce the friction of the logs in passing over the skids a liberal amount of skid-grease was used. On its arrival at the coast the log, with the aid of jack-screws, was pried over the brink on to the chute, down which it rolled or slid into the sea.

Men with "corked" boots, and wielding pike-poles, herded the logs into parallel rows within the confining limits of long boom-sticks, which were fastened together, end to end, by means of boom-chains fitted into auger-holes bored for the purpose. To keep the sides of the boom parallel, and to keep the logs from washing-out, cross-pieces, called "swifters," were placed over the logs at regular intervals and made fast to the boom-sticks by chains. At the head of the boom, and acting as a cut-water, were attached two sticks, forming an inverted V. At their apex would be fastened the tow-line of the tug employed to convey the boom to the mill.

The hand-logger was one who operated under special licence of the Government, permitting him to cut timber on unsurveyed Crown lands by means of nothing more than axe, saw, wedges, jack-screws and his own strength of arm. Some very fine timber, even at considerable distance from the sea-shore, was sent to the saws by these sturdy, resourceful men. The ideal location for their work was a fairly steep slope shelving into the sea. After felling a tree in the usual way, the hand-logger lopped off its branches, snubbed its nose and, by aid of wedges, jack-screws and skids, sent it sliding head-first down the slope into the sea. Making up a small boom in some snug cove, the hand-logger waited for a passing tug, that was travelling light, to tow it to the mill.

In the early 'nineties donkey-engines for hauling logs came into general use in the woods of British Columbia. At the present time, except on a small scale or in the interior, no oxen or horses are employed in the logging-camps of the province. At first the donkey-engine was placed on a scow,


SPRUCE 70,048 Million Cu.Ft.
BALSAM FIR 29,625 Million Cu.Ft.
JACK & LODGE-POLE PINE 29,256 Million Cu.Ft.
CEDAR 22,045 Million Cu.Ft.
DOUGLAS FIR 16,887 Million Cu.Ft.
HEMLOCK 16,145 Million Cu.Ft.
WHITE PINE 8,387 Million Cu.Ft.
OTHER SOFTWOODS 5,927 Million Cu.Ft.
POPLAR 29,496 Million Cu.Ft.
WHITE BIRCH 6,635 Million Cu.Ft.
YELLOW BIRCH 5,194 Million Cu.Ft.
MAPLE 3,944 Million Cu.Ft.
OTHER HARDWOODS 2,703 Million Cu.Ft.

RELATIVE AMOUNT OF STANDING TIMBER OF THE MORE IMPORTANT SPECIES IN CANADA

from which vantage-point it *snaked* the logs out of the woods by means of a cable wound round a drum. But this method was naturally confined to a limited area within the radius of a quarter of a mile. So the next step was to take the engine into the woods, haul the logs to a central yarding-place, remove the donkey the length of its cable nearer shore, and repeat the operation until the logs were drawn into the water. But, of course, the larger operators soon adopted the method of using several engines: one type, the "yarder," was employed to haul the logs from the woods to the main skid-road; a heavier type, the "roader," drew a string of logs, hooked end to end, down to the sea. To facilitate the working of the new system, a different type of road was adopted. Instead of the short cross-pieces, long logs, laid end to end, are used, forming a trough down which the string of logs is hauled to the sea.

The method of logging at present in vogue is known as the high-lead system. The area to be logged is carefully examined by the superintendent, who then decides upon the location of the various settings, and the type of high-lead to be employed. If the ground is fairly even, though not necessarily perfectly level, the simpler type of high-lead, worked from one spar tree, will probably be used: but if the timber limit is intersected by ravines or broken by hills, a modification of the high-lead, known as the overhead-cable or "sky-line" system, will most likely be installed in the more difficult parts.

In the simpler type of high-lead, a tree near the centre of a setting is selected as the spar tree. Up this climbs the high-rigger, who cuts off the lower branches, tops the tree at a height of seventy-five to two hundred feet, and attaches the steel guy-lines, tackle and cable, that are necessary to steady the tree and handle the logs. The high-lead block that carries the main-line cable sometimes weighs half a ton. To get this rigging to the top of the spar tree the high-rigger lets down a stout cord and draws up a light wire cable, known as the "straw-line," which he passes through a small steel pulley. Up the straw-line the donkey hauls the heavy block and tackle; the high-rigger makes everything fast, and his work is done.

On the donkey are two drums, one carrying the main-line

and the other the haul-back. At the end of the main-line is a stout hook, to which the "choker" is attached. This choker is a short piece of wire cable, with a hook at one end and a ring at the other. When a log is to be yarded from any part of the setting, the haul-back pulls the main-line to the spot, the choker is looped round one end of the log, its ring is slipped over the hook of the main-line, and the yarding-engine hauls the log to the loading-point at the spar tree. If a railway is in operation on the limit, the logs are loaded directly on the cars, which convey them to the sea and dump them into the booming-ground. If fore-and-aft skid-roads are used, the logs are hooked together in a string and drawn to the sea by "roaders."

When, owing to the uneven nature of the ground, the overhead-cable system is adopted, two spar trees, carrying at their tops a taut fixed cable, are employed. One spar is near the loading-point, the other may be across a deep ravine. Both trees are rigged in the usual way. After the far tree has been used as a yarding-point for all the logs within reach by the ordinary high-lead method, these logs are conveyed by the overhead-cable system to the loading-point at the foot of the nearer spar tree. Moving freely along the sky-line, or taut cable already mentioned, is a carriage-block, like an inverted bicycle with the tyres removed, to the suspended tail-bolt of which is attached the hook of the main-line. The main-line passes through the high-lead block on the near spar tree to a drum on the "yarder." Between these two blocks is another, known as the fall-block, through which the main-line also passes, and to which is attached the choker that hauls in the logs. The haul-back line leads from the fall-block, through a block on the far spar tree to one on the near tree, and thence to a second drum on the yarder. Both main-line and haul-back are operated by, and under perfect control of, the engineer. The logs are attached to the fall-block by a choker, lifted high above all obstructions, and conveyed to the loading-point by hauling in on the main-line.

Different opinions exist as to whether or not the high-lead system is less destructive of the smaller forest growth than the old method. A visit to a setting which has been logged by

the high-lead system will probably convince you that the battered and shattered fragments of the ancient forest have a poor chance of replacing the noble trees of the original growth.

34. BY-PRODUCTS OF THE FOREST

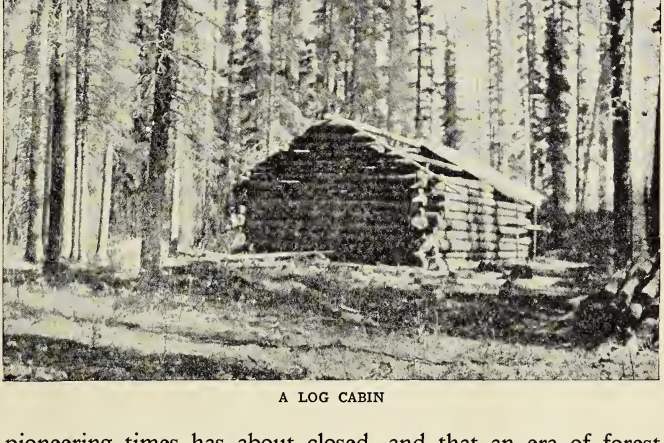
BEFORE the white man set his axe to a tree in the Canadian woods, the Indians had for centuries drawn upon the resources of the forest to supply many of their simple needs: material for bows and arrows, handles for their tomahawks, poles for their wigwams and lodges, fibre for mats, bark for canoes and household utensils, with gum or resin to close their seams, sugar from the maple, dyes from butternut and alder, medicines for every ailment, all came from the temple of the Great Spirit, the forest.

Bark and poles did not satisfy the white man: he required an acre of forest to build his cabin. Natural clearings did not suffice to grow corn and potatoes for his family: he must lay waste many acres of virgin forest to furnish him with fields. In doing so, he discovered that the ashes of beech and maple were valuable for the making of soap and potash: the soap he used, in moderation, and the potash provided him with a little ready money. But he did not despise or ignore the Indian's woodcraft: from him he learnt the art of extracting sugar from the maple and the medicinal virtues of many native plants. To catch the maple sap he used troughs hewn out of logs, and to convey the sap from the trees he used wooden spiles. Lacking an orchard, he was glad to gather wild berries, grapes, plums and the succulent fruit of the elder, so renowned as a filler for pies. When the fall came he took pattern by the squirrels, and laid in a good supply of butternuts, walnuts and hickory nuts. If his axe needed a new handle, a young hickory supplied it. From boles of the maple he fashioned bowls for the kitchen. In framing his doors and windows and his crude furniture, he employed wooden dowels in place of nails.

Thus did the Indians and our pioneer forefathers draw on what to-day we call the by-products of the forest. Even now

some of these products are indispensable to our rural population: but only one aboriginal industry has survived and increased to such an extent as to attain national importance, and that is the making of maple sugar. Quebec, Ontario and the Maritimes are the only provinces that are so blessed by Nature as to engage in this fascinating and profitable industry; but the rest of Canada and the people of the United States help to consume the delectable product.

Let us hope that the era of forest exploitation that followed



A LOG CABIN

pioneering times has about closed, and that an era of forest conservation has begun. One of the signs that such a change in policy has taken place is the increasing interest shown in the utilisation of forest waste. Bureaus of research are trying to discover new processes for the recovery of oils, acids and other by-products from the wreckage left by the logging operator and the saw-mill. That they are succeeding is evident from the many wood-using industries already established, such as factories and refineries for the destructive distillation of wood.

The distillation of wood, of course, is not a new process; for, in the early 'eighties, a plant for this purpose was established in the province of New Brunswick. It remained in operation

for only a few years, and no further enterprises of the kind were started until the outbreak of the Great War, when the demand for the substance *acetone*, used in the manufacture of explosives, gave a new life to the industry. The factories that sprang up to supply this need were located in Quebec and Ontario, where abundant supplies of suitable wood could be obtained. A refinery at Montreal treated the crude products of all the factories, some twelve in number, which, being of a portable type, could be shifted from place to place as the local supply of hardwood became exhausted.

Birch, beech, maple, oak and ironwood, too small or imperfect to be converted into lumber, are used for distillation. The process is the best example we have of true conservation; for it leaves absolutely no waste. Even small branches of trees are used. The slabs, edgings and trimmings from saw-mills, instead of going to the burner, may, by this new industry, be converted into products of economic value. By simple, double or fractional distillation this process produces crude wood alcohol, acetate of lime, various gases, methyl alcohol, acetone, acetic acid, creosote oils, tar, formaldehyde and charcoal—all out of forest material that would otherwise be wasted. Pine oil has been proved to be particularly suitable for use in the flotation process of extracting metals from ores. The charcoal is used for fuel, but will no doubt be of even greater use in the manufacture of iron and steel.

Some interesting forest products, which might be made commercially profitable, are those that are serviceable in medicine and the arts. Tannic acid is obtained from the red inner bark of the hemlock; and from the twigs of the same tree, by the process of distillation, is obtained the oil of hemlock. Canada balsam or Venetian turpentine, used both in medicine and the arts, is extracted from the balsam fir. Spruce gum is collected in the winter from punctures made in the trees during the previous spring. An oil valuable in medicine is distilled from leaves of the juniper, and the wood used in making lead-pencils comes exclusively from one species of this tree, known as the red cedar. The nutritious inner bark of the slippery elm gained much repute as a medicine in early

days, and people who suffer from sunburn have cause to be grateful for the demulcent properties of witch-hazel. Our wild cherry, particularly the black cherry of eastern Canada, yields hydrocyanic acid, of value in the preparation of tonics and also in flavouring extracts. Moosewood is used as an emetic.

This list might be much extended; but as a final example of what our forests yield in the line of medicines, mention must be made of the most widely used medicinal preparation of modern times, cascara. This is made from the bark of a small tree, a species of buckthorn, that is confined to the forests of the Pacific Coast. Its bark is stripped in the spring, dried and shipped to dealers, much of it going to Japan.

35. IN THE SUGAR BUSH

The white man learned the art of making maple sugar from the Indians. Perhaps from them, too, he learned to regard sugar-making time as a period of festivity. The Indians who dwelt along the banks of the St. Lawrence and the Ottawa opened the ceremony of sugar-making by offering the first-fruits of their spring boiling to the Great Spirit.

Several species of maple are annually tapped for their sugar. These include the Red Maple and the White Maple. But the species that is deservedly most popular is the Sugar Maple or Rock Maple, as it is sometimes called. Under favourable conditions of growth and environment this tree will attain a height of over a hundred feet and a diameter of five feet. For a maple, its bark is deeply furrowed, the ridges being broken up into irregular plates or patches.

Maples require lots of elbow-room. This fact has to be taken into consideration when laying out a plantation of Sugar Maples, especially as the amount of sap depends more on the spread of the top than it does on the height of the tree. The reason for this is plain when one remembers that the sugar in the sap is manufactured by the leaves.

The flow of the sap in the maples begins about the middle

of March, though in some years it may start a month earlier, or be delayed until the first of April. The flow lasts from three to six weeks, depending upon the weather. It is not considered wise to continue sugar-making after the buds begin to swell, as the sugar made at that time has a strong, disagreeable flavour.

In making maple syrup the sap is boiled until it has the consistency of new honey, after which it is strained and allowed

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MAKING MAPLE SUGAR—I.

The primitive method. Notice the uncovered wooden pail hanging on the tree, and the large iron kettle over the open fire.

to stand until imprisoned ants, twigs and other foreign substances have settled to the bottom. To produce the sugar the process of boiling is continued longer. Four gallons of sap are required to make a pound of sugar, and an average tree will yield about five pounds of this product. In the north-eastern states alone the annual output of maple sugar is over thirty million pounds.

The Indians and the early settlers tapped the maple-trees by cutting a notch in the trunk. The notch was usually about eight inches long and slanted downwards. At its lower end was inserted a natural spout formed of elderberry or sumac. The sap was caught in troughs hewn out of sections of logs.

Sometimes a double notch, forming a V, was used. Unfortunately, a tree so tapped usually died. When augers were introduced into the settlements, this wasteful method of tapping the trees was discontinued. To borrow an auger from his nearest neighbour, a settler would often travel many miles through the wilderness on snowshoes.

The wooden spile, with a groove to receive and conduct the sap, replaced the pipe of elder or sumac; and later still

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MAKING MAPLE SUGAR—II.

The first steps in progress: covered metal pails and a stone-boat for carting the sap.

came the galvanised metal spout or spile, which is now in general use. The crude troughs hewn from logs were succeeded by wooden pails; and these, in their turn, by metal pails with lids to exclude debris borne by the March winds.

In tapping the tree an auger-hole, not more than an inch in diameter, is made in the trunk, usually on the south side, about waist-high from the ground. The hole should not be too deep, or it will injure the tree. Through the bark and half an inch into the sapwood is sufficient. Though a large tree may be tapped in two places, the average tree should receive but one spile. On the spiles are hung the pails, which are of eight-quart capacity. These are emptied night and morning into barrels, drawn through the open woods on stone-boats.

The modern system of harvesting the crop of maple sugar is business-like and unromantic as compared with the method in vogue among the early pioneers. Sugar-farming is a recognised and prosaic business in the north-eastern states and eastern Canada. On each estate a well-equipped plant is maintained. Instead of the old iron kettles, slung in the open, there is an elaborate evaporator, like a long trough with innumerable partitions, down which the sap flows until its water-content is

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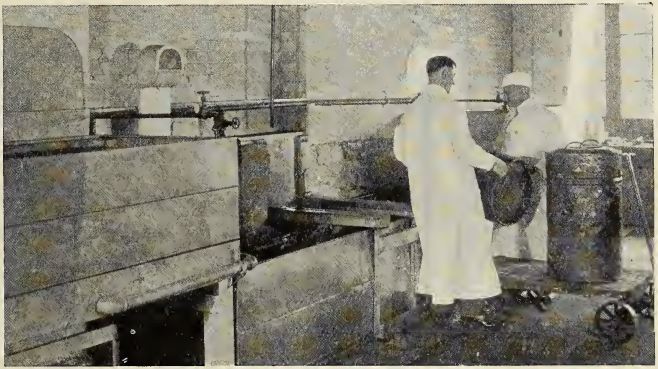
MAKING MAPLE SUGAR—III.
The pipe-line to the modern plant.

evaporated. By this method the sugar can be extracted from the sap in much less time than under the old system, and the product is more uniform in quality. But to one whose memory goes back to the days of the big black kettle, the factory-made maple sugar and syrup seem lacking in woodsy flavour.

When sugar-making once starts there can be no intermission in the hard work which it entails on all hands. But nobody grumbles. The boys who have been known to neglect filling the wood-box at home, will cut and pack wood all day, and day after day, to keep the fires going under the big kettles. There is rivalry as to who shall drive the team that hauls the stone-boat from tree to tree. Eager hands seize the half-filled pails and pour their amber contents into the sap-barrel. Mother

or Dad keeps a practised eye on the kettle with its simmering sweetness. Mary Ann and Jane Elizabeth guard the lunch-basket, and well they may, for hungry lads are waiting eagerly for a chance to sample the pumpkin-pie and doughnuts.

The weather is ideal for sugar-making. Frosty nights are succeeded by warm sunny days. The first boiling is coming to a critical stage. Mother dips into the seething kettle with a big ladle and pours some of the hot liquid on the snow. Grimy



Department of the Interior

MAKING MAPLE SUGAR—IV.

The interior of the modern plant. Notice the extensive apparatus and the scrupulous cleanliness.

little fingers seize the rich amber ribbons before they have time to cool. How good that first maple sugar tastes! Mother samples a little herself. She is more critical than the children, and decides that the sap must boil for another twenty minutes. What a time to wait! But even twenty minutes will pass if you wait for an hour or two. The sap is ladled into the moulds, fresh sap is poured into the kettle, the fire stirred up—sending showers of serpentine sparks into the dark canopy of maple-boughs—and Mary Ann announces that supper is ready.

After supper they sit around the glowing fire and sing the old-time songs or tell stories. Dad relates an incident that happened during his early days in the bush. It seems that

sickness in the family forced him to leave the sugar-camp for several days. When he returned he found a family of bears in possession. The mother bear was reeling about, trying to sober up after too much indulgence in the fermented contents of the sap-barrel. Stretched out on the snow, dead to the world, were the two cubs. When the mother bear saw Dad she made for him. But as she could not run in a straight line she had no chance. Dad sprinted for home to get his gun. He had visions of bear-steaks for a month to come! But he was doomed to disappointment. During his absence the mother bear, suspecting his intentions, had picked up her two cubs, and carefully avoiding the patches of snow, which would have revealed her tracks, she had carried her inebriated offspring to a place of safety.

THE TREES OF CANADA

From the list below, select the proper trees for filling in the blank spaces.

1. —— is the most important tree used for pulp. Its timber is also employed for mine-props, and chewing-gum is collected from sears on its trunk.

2. —— has the property of bending without breaking and is used in the manufacture of wagon-shafts, spokes of wheels, oars and baseball-bats.

3. —— is specially used for finishing lumber and is durable under water. It is used for fence-posts, telephone and telegraph poles, and for making shingles. It has flat, compact foliage as compared with other conifers.

4. The chief firewood in eastern Canada is ——, which was used by the pioneer settlers for the production of potash.

5. The largest timber in Canada is derived from the ——, whose strength fits it for structural purposes of all kinds. It is found only in one province.

6. —— is the second most important pulp-tree. It is used for making water-troughs, and its bark is good for tanning leather, while its lumber is less valuable than that of the pine or Douglas fir.

7. A famous Canadian tree is the ——, from whose sap is made an important food. This tree is also used extensively in the making of furniture.

8. —— is a hardwood tree that was most used by the Indians. It is now used in the making of furniture and floors.

9. —— produces splendid lumber, that is light, does not readily splinter, and is easily worked.

10. —— is used for pulpwood. Canada balsam is obtained from one of its species. It is general throughout the Northland.

11. —— is used in shipbuilding and for making pumps and tanks. It is the only conifer that sheds its leaves in the fall.

12. —— is an important pulpwood tree and is used in making excelsior. It is the chief deciduous tree in the prairie provinces.

13. —— is used largely in shipbuilding, and in the making of furniture and hardwood floors.

14. —— is the hardest of woods and is used in the making of axe-handles, while its nuts are gathered in the early fall and eaten in the winter.

spruce	true fir	ash
white pine	larch *or* tamarack	hickory
hemlock	maple	beech
cedar	birch	poplar
Douglas fir	oak	

36. THE WEALTH OF THE SEAS

In every age and in every clime, the waters of the world have yielded to man a share of his food. In capturing a fish from his native element there is a lure that appeals to the truant from school, with home-made fishing-tackle, adorned with a worm for bait, as well as to the deep-sea fisherman, whose struggle in landing a thousand-pound tuna on deck is a theme for a real epic of the sea. To those who live from the products of the soil, the calling of the fisherman seems profitable indeed. While the farmer must exercise the greatest care in selecting, feeding and rearing his live stock, and must buy feed for a considerable time before his produce is ready for sale, the fisherman in a few hours takes his catch, full-grown and ready for the market. It would seem that the harvest of the waters yields a quicker return than the products of the soil.

But the average yearly income of the 74,000 people engaged in the fishing industry of Canada is only $650, while the boats, nets, lines and general equipment of each fisherman cost, on an average, $400, and need to be constantly replenished. Fish suffers in comparison with meat because it only keeps fresh for a few hours. Those fish, like cod and herring, whose flesh is not oily, can be salted and shipped by water to distant countries, but oily fish like the salmon must be canned or frozen for shipping, which means an investment of capital that only large

Department of the Interior

SALMON FISHERS GOING OUT BEFORE DAWN

companies can undertake. There is never a steady demand for fish, as there is for butter, meat and milk, while the Canadian people eat less fish *per capita* than those of any other country. The fishing season is usually short, and the fisherman must pursue his dangerous calling both night and day while the harvest lasts.

No one knows better than the fishermen the treachery of the sea: the thick blanket of Newfoundland fog that suddenly cuts the little boats off from their own vessel; the terrific gales of early autumn, when the season is at its height; and the winds of October, heavy with cutting snow, that drive the fishermen home. They know the struggle of those who make port, and the sorrow for those who are lost in the storm.

Some fish, as the salmon, live in the ocean, but come back to fresh water to spawn; others, like the eel, live in fresh water and seek the ocean as a spawning-bed; while many, like the cod, both live and spawn in salt water. The larger fish eat smaller fish and the smaller ones eat those still smaller; hence few of the young fish live to maturity. For this reason fish lay a large number of eggs, the cod yielding as many as nine million in a season. Only about 5 per cent of the herring destroyed fall a victim to man. The whales devour cod and herring, while the cod and mackerel pursue the herring, which in turn eat the eggs and young of other fish. What do the newly hatched fish eat? First they are started off with a food-basket or yolk-sac that must keep them alive until they can find their own natural food, plankton, small animal and vegetable forms that float in shallow northern waters. How the fish that spawn in the upper courses of rivers find their way to the very spot where they were hatched, and travel on the self-same course that their parents took, is one of the marvels of instinct. Think of the eels in Europe and America, feeling the urge to visit the salty ocean, travelling for weary months over land and water until they arrive at a certain place in the ocean south of Bermuda! There, at a depth of nearly two miles, the eggs are laid, and the ribbon-like young eels develop. The life-history of this fish has been only recently learned, for no one ever found the eggs or the young of the eel in fresh water. When the eels are nearly grown, they feel the desire to visit fresh waters, and the European and American species separate, each seeking its own country.

Fish probably have no sense of taste or hearing, and are very near-sighted, as the lenses in their eyes are round, to enable them to see under water. Flat fish, like the halibut, have one movable eye. In the case of those living in cold waters, the left eye migrates to the right side of the head, and those inhabiting warm waters have the right eye travel to the left side. The dark and cavernous depths of ocean contain many strange creatures of the water-world which never fall a prey to the fisherman. The area of the sea is three times that of the land, and fishing-hooks dragged over its shallowest parts would

ensnare only a few of its denizens. At times a great storm or upheaval tears loose and washes ashore tons of fleshy matter from some creature whose home is on the ocean floor.

Fish spawn in shallow waters where their young can find plankton for food; and Canada contains two of the four great fishing-grounds of the world, one on either coast. With its many bays, the Atlantic coastline from Labrador to the boundary stretches for over five thousand miles, while the indented coast of British Columbia extends for seven thousand miles. With its numerous lakes and mighty rivers, Canada contains half of the fresh water on the globe. To the value of the fish in these well-stocked waters must be added the fact that, the colder the water in which fish are taken, the better are the quality and the means of preserving the produce. The great fishing "banks" of Newfoundland are within easy reach of the fishermen from the Maritime Provinces and Quebec. The fisheries of the Atlantic are divided into deep-sea and inshore fisheries.

As in every other industry, modern methods have entered the fishing business, with the result of greater production. The sailing schooners of the old fishing fleets on the "banks" of Newfoundland have changed their methods from line-fishing off the decks to boats manned from their crew with trawls and seines, while the forty- to hundred-ton schooners are giving place to steamers 150 feet long. The picturesque sail-boats of inshore fishing are being rapidly replaced by gasoline launches. Canneries are taking an increasingly large part of the catch, and are finding new markets abroad, while the former wastage is being turned to practical use. The Dominion Government is conserving the supply of fish, providing hatcheries, stocking new waters with valuable fry, and studying problems affecting the industry. Sixty per cent of the annual catch is exported, of which the United States takes one-third and Great Britain one-fifth.

Italy and Brazil are large buyers of codfish, and the Chinese have lately developed a taste for herring from British Columbia. In 1870 the production of fisheries in Canada was $6,600,000, while in 1925 it was $48,000,000. Although the waters adjoining eastern Canada have been fished since the days of Cabot and

Cartier, they are still yielding each year a harvest of greater value. The worth of the fishing industry in Canada caused the French and English to struggle for the conquest of North America, and the wealth of our fisheries will be ever open to those of our people who are bred within sight of the sea and are lured by the call of wind and tide.

VALUE OF PRODUCTION

Province	1870	1900	1925
	$	$	$
Prince Edward Island	—	1,059,193	1,598,119
Nova Scotia	4,019,425	7,809,152	10,213,770
New Brunswick	1,131,433	3,769,742	4,798,589
Quebec	1,161,551	1,989,279	3,044,919
Ontario	264,982	1,333,294	3,436,412
Manitoba	—	—	1,466,939
Saskatchewan	—	718,159	494,882
Alberta	—	—	458,504
British Columbia	—	4,878,820	22,414,618
Yukon Territory	—	—	15,370
Total	6,577,391	21,557,639	47,942,122

FISHERIES PRODUCTION BY PRINCIPAL KINDS, 1925

Each over $1,000,000 in value

Kind	Quantity	Value
	cwt.	$
Salmon	1,933,260	15,760,630
Cod	2,309,000	6,232,821
Lobsters	340,838	5,552,977
Halibut	340,007	4,185,391
Herring	2,413,973	3,117,841
Whitefish	186,648	1,990,108
Haddock	344,386	1,171,555
Trout	81,292	1,097,728
Pickerel or Dore	86,877	1,056,169
Smelts	76,795	1,035,504
Sardines	158,533	1,017,206

37. THE SALMON INDUSTRY

THE Sockeye and Spring salmon are the choicest of all edible fishes. Fried, baked, or canned, the red flesh of the salmon has a delicacy of flavour and a richness of food-content shared by no other fish. The life-history of this popular fish is most interesting and better known than that of any other, because it adds to the value of the fisheries of Canada nearly sixteen million dollars yearly, or more than two and a half times that of the cod. Grave fears have been entertained for the future of the salmon industry, because of the large number taken each year, leaving fewer to spawn, and because of barriers in the rivers, such as dams and blasted rocks, which prevent the salmon from reaching their spawning-grounds near the sources of the rivers. The pollution of rivers and lakes by sawmills has cut down the supply of fish, like the salmon and shad, which spawn in fresh waters. A careful study of the life-history of this fish by officials of the Dominion Government has led to the restocking of the salmon streams of British Columbia with fry or small fish and eggs to the total of millions each year, so that the future of the industry is assured.

The salmon stays for the first two years of its life in the upper reaches of the river in which it is hatched. It then goes out to sea, and when fully matured—the Sockeye at four years of age and the Spring salmon at seven—it returns to the place where it was hatched, to deposit its eggs and complete its life-cycle.

In the midsummer of their last year the salmon, in the fullness of vigour, and with one great purpose, assemble in hordes at the mouths of British Columbian rivers, to begin the most difficult journey ever undertaken by any living creatures. Of all the shining and supple bodies, heading for the quiet waters above the high hills, only a few will win through, wearied, bruised and battered. First the fishermen take their toll, then the rapids bar the way. They try again and again, flinging themselves into the maze of boiling rapids, only to be tossed back. While resting in quiet waters to renew their

strength for the struggle, they are speared by the Indians. Those few that win through achieve their ambition by preparing for the continuation of their race. The males plough out with their bodies a trench in shallow water where air-bubbles cling to the pebbles, and there, in fresh running water, the female lays in the trench her three thousand eggs, the size of red-currants. When the eggs are covered with gravel, the parents can do no more; their life-history is completed, and they drift, helpless and dying, tail first, out to sea.

Hungry fish may burrow into the gravel mound and devour the eggs, so that only a few are likely to hatch at the end of five months. About their necks the little salmon or "fry" have yolk-sacs, which furnish them with food until they are able to discover their own. During the two years they stay in fresh waters, the young salmon are beset by many perils, being sought by trout, ducks and eagles, while some are stranded in streams that become dry. Having braved the perils of the river, the young salmon finds many dangers awaiting it as it enters the ocean. If it escapes the fisherman's net, it may fall a prey to the sea-lion, which takes only a bite from each fish, or tears off the skin for the sheer love of destruction. The age of a salmon is easily told by the markings on its scales, even as the age of a tree is told by the number of rings in a cross-section.

During the spring months salmon are caught in small numbers by boats with hook and line, but when the salmon-run in midsummer begins in earnest, the fishermen, in obtaining their catch, follow three different methods: trap-fishing, seine-fishing and gill-net fishing. As some mysterious instinct urges the salmon to follow the same course up the rivers as did their predecessors, now turning toward one bank at a certain spot and again toward the other, the fishermen, by careful observation, learn the precise places where the fish may be easily taken, and there they place trap-seines stretched to posts. As the salmon swim near the surface, the seine does not require to be set at the bottom of the river. The fish wander from one pocket of the trap to another, until they reach such narrow quarters that they are easily baled out into scows.

Seine-fishing is the most modern way of gathering in a

school of fish swimming over a great area. A large net or seine is let out on the water from a tug, launch or sailing-boat. After being trailed for a few hours, if it is drawn into a pocket by a rope to enclose the fish, the method is known as purse-seine fishing; but if one end of the seine is fastened to the bank and the other end dragged ashore, the operation is known as drag-seine fishing. In either case the top part of the seine is kept at the surface of the water by being attached to wooden blocks which act as floats.

In gill-net fishing the seine is worked against the current,

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IN A SALMON CANNERY

Of what nationality are the workers? What is the purpose of the pipes coming down from the ceiling?

so that the salmon are enmeshed by the gills. Nets of a certain opening are used for Sockeyes, while those of a larger opening take Spring salmon. This method secures more salmon than any other. Only on the Fraser River are gas-boats allowed to handle gill-nets, and this is given as another reason for the smaller runs of salmon occurring there.

There are sixty-five canning-factories for salmon in British Columbia, centring round New Westminster and Steveston, at the mouth of the Fraser, and along the Skeena from Prince Rupert to Hazelton. There the fishermen count out their catch at a fixed price per head, and there the fish, robbed of its heart's desire, passes with dispatch from one expert worker to another,

where in deft movements it is split, gutted, cleaned, trimmed, cut, and packed into cans, which begin a long journey on trays, over the weigher, through the cleaner, and into the steam vat, where they are cooked for one hour and forty minutes, until even the bones are soft. After being sealed and labelled, the cans are ready for shipment to the Prairie Provinces and to Great Britain. There is also a growing demand for canned salmon in Australia, South America and Southern Europe.

Fish hatcheries in British Columbia are safeguarding the salmon industry for the future. Fertile eggs are planted in the river-beds, and fry are hatched and placed in suitable waters. Two important hatcheries are located at Terrace on the Skeena and at Owl Creek on the Birkenhead River, which flows into Lillooet Lake. In autumn the fish are barred from going upstream near the latter hatchery, and there families of Indians swarm, to spear the salmon into crates, and to smoke and dry the fish thrown aside after the eggs are secured by the skilled white "spawners." The plant now holds forty-five million eggs, which are hatched under ideal conditions, and the young salmon in the tanks, when they feel the urge to try their fortunes outside, slip down the drain-pipe and take their chances in the great water-world.

38. COD-FISHING

When Britain laid claim to North America and fought the Seven Years' War for the mastery of a great continent, the natural wealth of the New World that was considered of prime importance was not gold, timber or farm-lands, but the codfish of the banks of Newfoundland. Since the days of Cartier, the capture of this staple fish has lured fishermen to the eastern coast of Canada; but after nearly four hundred years the industry still yields to the Maritime Provinces a profitable return of over six million dollars annually.

The cod is valuable as a food fish because of its size, flavour, smallness of bones, length of fishing season, and fitness for

dry-salting. While its flesh is free from oil, a medicinal product is extracted from the liver, known to children in many lands as cod-liver oil. This fish is very particular about the temperature of the water it inhabits, seeking those colder seas which are constant at forty to forty-five degrees. The cod does not move in schools like the herring, but is a "ground fish" like the halibut, and swims in water from eight to forty fathoms deep. The cod has a voracious appetite, feeding on herring and other small fish, as well as crustaceans, worms and molluscs, while in its stomach have been found rare fishes, stones, leather, and even glass.

The eggs of the cod, laid from October to June, are about one-nineteenth of an inch in diameter, and from five to eight million are laid by a single fish. It is said that if every egg of the cod hatched, and the young all grew to maturity and spawned, in ten years the ocean would be a solid mass of codfish. Since the eggs float on the surface of the water, many are washed ashore, eaten by birds, or devoured by other fish. Cod have been captured six feet in length, weighing two hundred pounds, but the usual size of those taken on the "banks" is between ten and thirty-five pounds.

Lunenburg, on the Atlantic side of Nova Scotia, is the most important fishing-town in the Maritime Provinces. The days are nearly numbered for the picturesque sailing-schooners, with their trim lines and white sails, but the cod fleet from Lunenburg still hoists its canvas to the winds and sets sail in spring for the fishing-banks of Newfoundland, where, outside the three-mile limit, it competes with steam-trawlers from other countries for the season's catch.

The Nova Scotia deep-sea fisherman is a picturesque character. His weather-beaten and deep-seamed countenance tells the story of mighty struggles against the elements on the dangerous deep. He is ill at ease on land, walks with a rolling gait, and is comfortable only in sea-boots and oilskins. He can knot a rope and make it serve as a human hand, keep a steady footing on a rolling and slippery deck, and find his way beyond the shore-line as easily as does a city man on a marked street. Without fear, he meets the great waves in an

Department of the Interior

LAYING OUT CODFISH TO DRY

open boat while searching the sea for cod, and, with little knowledge of navigation, he sails in winter with his salted catch to the far-off shores of Cuba and Brazil.

Each schooner carries ten little boats, called dories, each manned by two fishermen, who set off from the vessel every morning with a trawl-line, which they anchor to the bottom and buoy to the surface of the ocean. From the trawl-line are placed a number of hooks, baited with herring. When each boatload of fish reaches the schooner, the cargo is counted out, for each fisherman is paid according to his catch. The fish are cleaned and washed as they are caught, then salted and packed in the hold of the schooner. Steam-trawlers usually pack their catch in ice and make port every two weeks to market their fish; but the schooners may stay out for six weeks at a time, salting the cod, which are later taken to winter markets in the West Indies and South America.

As many as fifty thousand tons of salt are used, which, before 1916, were purchased from Turk's Island in the Mediterranean. But in that year a valuable salt mine was discovered in Nova Scotia. This is now supplying in increasing quantities the demand for this necessity, for its product, more easily available, is also of better quality than that evaporated from sea-water, which has a tendency to redden the cod. When salted, cod keeps a very long time, and is specially desired by the people of warm countries, such as Italy and South America.

39. THE LOBSTER INDUSTRY

THE lobster is the spider of the sea. His home is on the ocean floor, in water from six to six hundred feet deep, on that part of Canada's continental shelf extending from Labrador to Maine. In appearance like the spider, even to his eight legs, he also resembles him in being a cannibal, and in lurking in crevices to seize his prey. Even though girded for the fray with a suit of armour, sensitive feelers and huge pincer-claws, the lobster cannot hold his own against his two great enemies:

codfish and man. The demand for lobster salad has exhausted the supply of this shell-fish or crustacean from American waters, and while the catch at present is more important than that of any fish to the Nova Scotia fishermen, it must rapidly decrease in the future, unless traps are used that will take only lobsters of a certain size.

Lobsters are greenish-red in colour, and do not become scarlet until they are boiled. It is said that the meat is best flavoured when the poor creatures are placed alive in cold water, which is slowly brought to the boiling-point. A lobster may weigh as much as twenty-five pounds, and live to be from fifty to a hundred years old. Its legs are too small to support its heavy body on the ground, but the buoyancy of the water enables it to walk with ease on the ocean floor. The ends of the two great claws are different: one is for seizing and the other for crushing. If one claw is caught fast, the lobster has the power and the will to amputate it, and then a new claw grows in the place of the other.

The lobster seeks its food at night, and detects its prey with its long sensitive feelers. Although it is a great scavenger, and feeds on the dead fish that finally settle to the bottom of the ocean, the lobster prefers fresh food when obtainable. This creature is a cannibal by nature, and would devour others of its kind, if the young were not scattered by hatching. Lobsters, like dogs, will drag their food to some secret spot, where they bury it and then mount guard for its protection. In defending their catches they are often wounded, and carry scars for the rest of their lives. The lobster has no need for the services of a dentist, for he is supplied with three separate sets of teeth. In his outer mouth are teeth for tearing the food to pieces; in the inner mouth the chewing is done more finely, and between the two stomachs are five large teeth which grind the food properly.

The lobster changes its coat several times by moulting. The second day after hatching it moults, and repeats the operation for five or six years, until it is fully grown. When it is half grown, six weeks are needed for the moulting process. The skin splits first near the tail, after which it bends into a

V-position that splits the skin along the back. The greatest difficulty is experienced in drawing the claw from the old shell, as it has to be pulled through the joint, one-quarter the diameter of itself. Like the frog, it also draws out the lining of its mouth and stomach. The lobster is glad to be rid of its old shell, which has become encrusted with barnacles and all kinds of parasites.

The female lobster lays from three thousand to one hundred thousand eggs, which she glues to the underpart of her body. Six thousand eggs weigh one ounce, and they stay on the body for ten months, until hatched. Lobsters lay eggs every other year. As soon as the eggs are hatched, the young float to the top of the water. No life-insurance company would take a risk on a young lobster's life; for, from a hatch of fifty thousand eggs, not more than a dozen would live to fight in coats of mail, as young lobster salad is a spring dessert relished by every fish.

Lobster-fishing is carried on along the Maritime coast, and is wholly inshore. The lobster is caught in traps or "pots," from two and a half to four feet long, by two feet wide, and one and a half feet high, in the form of a half-cylinder. The ends have funnel-like openings through which the lobsters crawl, with no possibility of return, to take the bait of stale herring, spiked to the floor. In summer the lobsters are found in shallow water, but in winter they travel out to the warmer currents in deep water. For this reason summer is best for lobster-fishing, and, as the lobsters feed at night, the weighted traps are lowered once a week at sunset, tied together by anchored ground-lines, and attached to ropes having wooden buoys painted with the owner's mark. Each lobster-fisherman sets from fifty to two hundred traps and uses, in tending them, a motor-boat from twenty to thirty feet in length. Live lobsters, and freshly boiled ones, packed in ice, are shipped to Boston and New York; while most of those taken in the Gulf of St. Lawrence are canned. The lobster industry in Canada ranks third to the salmon and cod, and was valued in 1925 at $5,550,000.

STEPS IN LOBSTER-CANNING

Department of the Interior

I. THE ARRIVAL OF THE LOBSTERS AT THE FACTORY

The catch is weighed and the fisherman credited.

Department of the Interior

II. THE LOBSTERS ARE BROKEN UP

Department of the Interior

III. CAREFUL WASHING FOLLOWS

Department of the Interior

IV. THE MEAT IS PACKED IN CANS

40. THE HALIBUT

THE halibut, noted for its white, firm flesh, is one of our most important food fishes. Its name means the "holy" fish, as it was eaten on holy days. Living in the crevices and alleys of the ocean floor at a depth of from two hundred and fifty to four hundred fathoms, it burrows in the sand to hide from its enemies and to catch its prey, appeasing its voracious appetite with lobsters, crabs, cod, herring and mackerel.

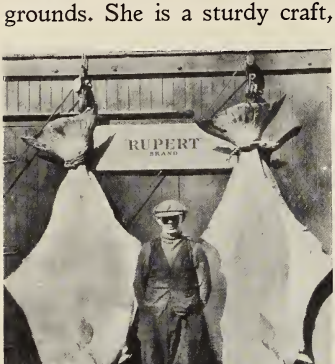
The halibut is a flat fish, the largest of the flounder family. Those living in the cold, northern waters are coloured on the right side, and the eye on the left side of the head migrates over to the right side. These strange characteristics of colour and eye may be caused by the fish lying on its side when concealed in the silt of the ocean bed. The very young are never caught by the fisherman's hook, but those taken before maturity are known as "chicken" halibut. The males do not exceed fifty pounds, but the females commonly weigh as much as two hundred pounds, and have even been captured ten feet in length, weighing four hundred pounds. The eggs from such a fish would be all that a man could carry.

In Canadian waters the halibut inhabits the deeper parts of the continental shelf from Cape Flattery to Alaska, and is taken at a greater depth than any other fish. Those living below 250 fathoms have soft, spongy flesh, to withstand the great pressure of the water. The halibut season in British Columbia opens on 15 February and closes on 15 November. The industry centres round Prince Rupert, known as the "Grimsby" of the Pacific, where the industry really began in 1903 with a catch of ten million pounds. This fishing-port now handles a catch of thirty million pounds a year, valued at over four million dollars.

Prince Rupert contains one of the largest cold-storage fish-plants in the world, and, being a terminus of the Canadian National Railway, ships trainloads of frozen halibut to Eastern Canada and New York. This enterprising city has a fish

exchange, where the halibut are bought every morning; and here also is located a Dominion Experimental Station, for studying the best methods of expanding the industry.

The halibut vessel leaves at midnight for the fishing-grounds. She is a sturdy craft, sixty feet long, burns fuel-oil, and carries five dories and a crew of thirteen men. Large quantities of frozen herring are carried in the hold for bait, and on the deck are miles of fishing-tackle. The same method of trawl-fishing is used for halibut as for cod, except that the hooks, each trailing a herring as bait, are lowered by weights to a greater depth. A dory with two men will handle from five to seven trawl-lines, each half a mile long, trailing baited hooks. The lines must not be left down for an hour, or the dogfish will devour all of the halibut except the bones. These latter fish are so named because they hunt in schools or packs like dogs, driving the small fish before them up to the very shore. They also cut the trawl-lines in two and cause great damage to the fishing-gear.



HALIBUT CAUGHT AT PRINCE RUPERT

When the dories reach the schooner, the halibut and cod are carefully counted out, cleaned and packed in ice and placed in compartments in the hold, so that they will not be damaged by pressure. One-fifth of the catch goes to the ship, which provides the fishing-gear; and the remaining four-fifths is divided equally among the men, the captain receiving an extra commission from the owners of the ship. In bad weather the fishing is done from the deck of the vessel, and the trawl-lines are hauled in by machinery. The ship carries fuel and provisions for a five-thousand-mile trip, but if a heavy catch is made, the captain hurries to Prince Rupert to make a good

sale of the fish, which sometimes brings as high as twenty cents a pound, with the possibility of each of the crew netting nearly two hundred dollars for a ten days' cruise. Often, however, they may work twenty hours a day and not make a quarter of that amount.

The Americans can fish within three miles of the coast, and may take shelter in our harbours during storms. They are carefully watched by Dominion patrol-boats, to see that they fish only beyond the three-mile limit. As our halibut-fishing is a "deep-sea" industry, it is open to world-wide competition, and three-fourths of the halibut landed at Prince Rupert is brought in by American vessels and shipped by rail to New York in bond. Canada pays a duty of two cents a pound on all halibut shipped across the border, yet when the price is high in early spring, a large part of our catch finds its way into the American market.

41. SCHOOLS OF HERRING

HERRING are the most important food fish in the world, being specially prized by the people of Europe. William the Conqueror's landing in England was unopposed because the English fleet had disbanded at the opening of the herring season. The wealth and sea-power of the Dutch Republic in the seventeenth century were founded on the herring fisheries.

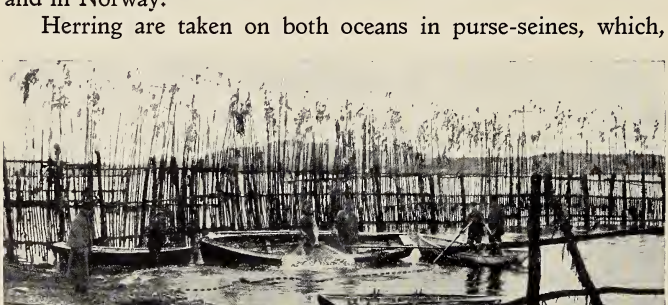
The life-history of this very common fish is not well known. It inhabits the northern waters of both oceans, swimming in schools countless in number; and though swarming in shallow waters, as the North Sea and the Gulf of St. Lawrence, to escape such enemies as the whale, cod and halibut, it also seeks its food of "red feed" and shrimp in the deep ocean.

The herring lays from ten thousand to fifty thousand eggs at different seasons, varying with the species. In February billions of eggs are laid on the eel-grass at Departure Bay, Vancouver Island, and, after a great storm, windrows of herring eggs six inches deep have been washed ashore, which at such times are a call

to feast for all feathered folk. A curious fact about this fish is that it is most edible during the spawning season.

The herring ranks fifth in value among the fish of Canada, the catch each year being worth over three million dollars. It also has a very valuable use as bait for cod, halibut and lobsters. A very important experiment carried on by the Dominion Department of Fisheries over a number of years led to the conclusion that deep-sea herring-fishing on the Atlantic would add greatly to the value of the industry, as it does in Scotland and in Norway.

Herring are taken on both oceans in purse-seines, which,



Elizabeth R. Holt, New Brunswick

SARDINE WEIRS

after being spread out over the water and weighted like salmon seines, are drawn together by a rope, and the fish, sometimes to the extent of fifty tons, are drawn into a pocket and baled out into the boats. The Atlantic catch is salted, packed in kegs and sold across Canada, those taken off the Labrador coast being of prime importance. The Pacific herring industry centres round Vancouver Island, particularly at Barclay Sound, where the business was begun in 1905, when a market for the fish was developed in China. After being caught, the herring are placed in salt brine for four days, then packed into boxes for shipment. Nearly two million dollars' worth are sold each year in the Orient.

Young herring or sardines are taken on the New Brunswick shores of the Bay of Fundy by weir-fishing. The weir is a brush-fence built on the mud-flats when the tide is out. When the great Bay tide returns, it sweeps over the weir, but some of the fish it contains are caught within the brush when the tide recedes. In this way many sardines are taken which find their way into cans, and later appear in sandwiches for cold lunches.

Pilchard Oil.—The pilchard is a member of the herring family whose young, when canned, are the sardines so esteemed in Europe. Because it contains so much oil, the pilchard has never found favour in Canada. Every year, in June, they swarm in countless billions in the waters on the west coast of Vancouver Island, though they are not worth the taking, for even the Indians consider them worthless for consumption. In 1925 the Government allowed the reduction of pilchards for oil, and at once a great industry came into existence. Pilchards are taken in purse-seines, many tons at a haul, and fed into machines at the fifteen reducing-plants on Vancouver Island. The oil is extracted under great pressure, is of a golden colour, odourless, and sells from thirty to fifty-five cents a gallon, a ton of fish producing sixty gallons of oil, while the plants have a capacity of twelve thousand gallons a day. Specially constructed tankers convey the oil to Europe, where it is used in the making of the most delicate toilet soaps and the finest of varnishes. The remaining flesh is ground into fish-meal and sold for chicken feed, while the bones are pulverised and used as a fertiliser in the fields of Japan.

42. THE SEALING INDUSTRY

The seal is one of the most wonderful of all living creatures, because it roams the seas like a fish, yet it also lives on land as other animals do. In the deep it is more at home than the fish which it captures with such ease; yet in its puppyhood days the seal loves to play in summer in green Arctic meadows. It must be taught by its mother to swim before it answers the

call of its race, to seek its food from the sea and float on the cradling billows.

There are two great classes of seals: the true or hair seals, and the eared seals. The most important branches of the latter family are the sea-lions and the sea-bears, or northern fur seals. The true seals largely inhabit the cold waters from Newfoundland to Greenland, while the eared seals are found along the shores of the North Pacific and Bering Sea.

Seals are more in number than any other kind of wild animals, and from the countless herds in northern waters more than a million a year have been slaughtered. There are two main kinds of seal-hunting, corresponding to the two great classes of seals. Let us begin with the eastern industry, which centres round St. John's, Newfoundland. Any craft engaged in the capture of seals is called a sealer. On the first of March the seal-hunters, in sailing-vessels, leave the harbour, and by the middle of the month the steamers also depart for the northern ice-fields. By sail or steam the hunters expect to reach their prey by the first of April, as the hunting season lasts during that month.

The seal that they hunt is the grey Greenland seal. About the middle of February the young are born singly on the ice-floes. At birth a seal weighs only five pounds, but a month later its skin, with the adjoining fat, weighs from forty to fifty pounds. It is these month-old pups that the hunters seek. They are clubbed over the heads with long spears; one deft stroke of the knife opens the whole length, and the body is tipped out on the ice. The heart is sometimes taken for food, but the prize is the skin, which is worth from one and a half to three dollars, and when tanned into leather is used for making shoes, valises, and belts for machinery. The fat is reduced and used in making lubricants. Sometimes at the end of the season a vessel sails homeward with twenty thousand pelts aboard, and although the yearly hunt now yields about two hundred and fifty thousand, forty years ago it totalled a million.

While the true seal drags itself along on its front flippers, the eared seal uses all four in moving on land. The sea-lions, on the Pacific Coast, are of little value commercially except

to the Indians of Alaska, who eat their flesh, make threads from their sinews, burn their fat for fuel, and make shoes from their skins. Although the males weigh twelve hundred pounds, are often thirteen feet in length, and fight fiercely among themselves, yet in the presence of man they are great cowards. A small boy with a pop-gun could put ten thousand to flight. When the grass is wet, or covered with dew, the Indians, by opening and closing an umbrella, drive the sea-lions inland over slippery herbage to their homes, where they are shot as desired. These animals, when captured, easily become pets, are fond of music, may be taught tricks, are more intelligent than seals, and are often exhibited in theatres and circuses as trained seals. They sleep on the rocks near shore, and when disturbed emit a curious roaring sound. In this way early navigators in a fog were warned of their approach to dangerous rocks.

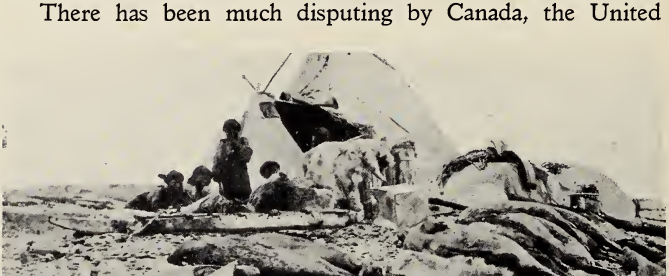
The sea-lions are very destructive to salmon, as they take only one bite from each fish. The canneries pay a bounty of $2 for each animal slain, and as the skin is worth $4, an experienced crew goes north each summer and destroys from two to three thousand.

The northern fur seals make their summer home in countless thousands on the rocky shores of the Pribiloff and Commander Islands in the Bering Sea. In March the males appear to select their rookery, or home. These males, that are to be the heads of families, are over six years old and weigh up to five hundred pounds, while the females, or cows, weigh only about eighty pounds. For three months after the males arrive they eat no food, scarcely take a drink and do without sleep. During this long period they fight with one another for the best location on the rocky shore. The bachelors, or young males, arrive next and take up their homes on the land, where they sleep most of the time, and where they are found by the seal-hunters, driven inland to pens, clubbed over the heads, and slaughtered for their skins, which are at their best when three years old.

The females arrive in June, and many together choose their homes with the males who have won out in their fight for the best location.

The pups, one to the family, are born in June. These baby seals are black, spend their time in playing on the sands, and do not learn to swim until August. Although there are thousands of pups in a group, and they all look alike, each is known by its mother, who goes fishing for two or three days at a time and then returns with a plentiful supply of milk for her youngster. The female seals winter in the warm waters of the south, while the males winter between California and Alaska.

There has been much disputing by Canada, the United



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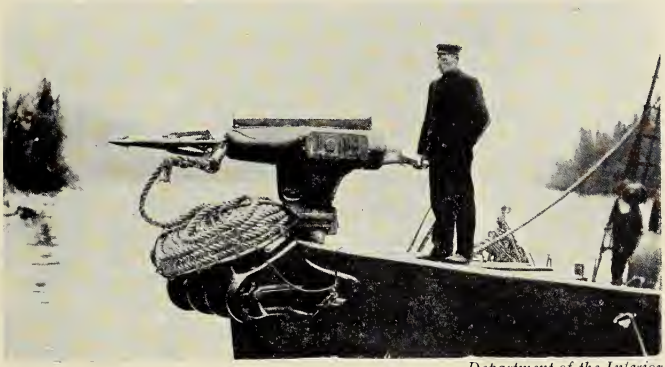
A CATCH OF SEAL

Notice the shelter at the rear. Of what nationality do you think the hunters are?

States, Japan and Russia about the rights of each in the sealing-grounds of Bering Sea. In 1911 a treaty was made, binding these countries for a period of fifteen years from slaughtering the seals at sea. Only the bachelor seals, three years old, are taken inland. In 1867 the seal herds of the Alaskan coast were estimated at from two to five million, while in 1911 they were reduced to less than one hundred thousand. Now the number has greatly increased, and probably the treaty will be continued for years to come. The limit of young males that may be slaughtered each year is 180,000. The skins are worth from thirty to fifty dollars each, but the skins of the old males are useless. The Coast Indians are allowed to kill the seals on their journeys north, providing they use a dugout and hunt with the spear.

43. THE WHALE

WHALES are of two kinds—the whalebone or baleen whale, and the sperm or toothed whale. The baleen whale has a sieve of whalebone, branching at the back of his mouth into fine bristles, which act as a trap and strainer for the small jelly-fish and crustaceans which he takes in with a mouthful of water. The sperm whale has in the lower jaw forty-four



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HARPOON GUN

Notice the harpoon projecting from the gun. Why is the rope attached to it? Why is the capture of the whale less dangerous than formerly?

large teeth, which fit into pits in the toothless upper jaw. It receives its name from the huge tank of sperm-oil, weighing about four tons, which is located in the top of its head.

Whales, in the dim ages of the past, were land animals who were driven into the sea by fiercer beasts. In their skeletons are still to be found the traces of legs, and they are warm-blooded and suckle their young. The tail of the whale differs from that of a fish, in that it moves up and down instead of from side to side, which enables him to dive to a great depth, sometimes half a mile, and drives him ahead with an undulating

motion. As they are direct descendants of the animals of prehistoric days, whales are long-lived and roam the seas for hundreds of years. The whales that appear to-day may have been sighted by Sir Francis Drake when he first entered the Pacific. Like other animals, whales need fresh air constantly, and must come to the surface of the ocean to breathe. How are they able to remain so long under water without breathing? One part of the blood is being purified while the other part is

J.H. A. Chapman, Vancouver

WHALE LASHED ALONGSIDE STEAMER

circulating, and extra air is stored in the lungs to serve the double purpose.

The baleen whale is killed for the whalebone, and the sperm whale for the sperm-oil in its head. Whalebone splits like cedar, is tough as steel, when bent recovers its shape, and is light as wood. It is used for whips and umbrella-ribs, and in finest fibres is woven into silk.

The sperm whale is a great enemy of fish, and one, when opened, was found to contain three hundred mackerel. This whale also tears from rocks the deadly octopus which lurks in the depths of the sea. A killer whale, when slain, was found to have devoured fourteen seals.

Joy-riding behind a whale is practised no longer. In the

good old days the crew from a whaler, on sighting their prey, manned the whaling-boat and pursued the monster. From the bow the harpooner hurled at the whale his weapon, which was tied by a long rope to the boat. When the harpoon found its mark in the whale, the crew began their furious ride of death behind the world's greatest steed. Now the harpoon gun is fired from the whaling-steamer, and the capture of the whale is not so dangerous as formerly.

When the dead captive is drawn up to the ship, air is pumped into its body to keep it afloat. A use is found for almost every part of the whale. The fat is made into soap, candles, lard and "face creams"; the skin is made into leather; the teeth are the best of ivory, and the meat is canned or made into fertiliser. Ambergris, a foamy substance that comes from the liver, is sometimes given out by a dying whale, and may be worth as high as ten thousand dollars. It has the power of fixing scents, like the attar of roses. An American sailor, not knowing its value, once greased his shoes with several hundred dollars' worth.

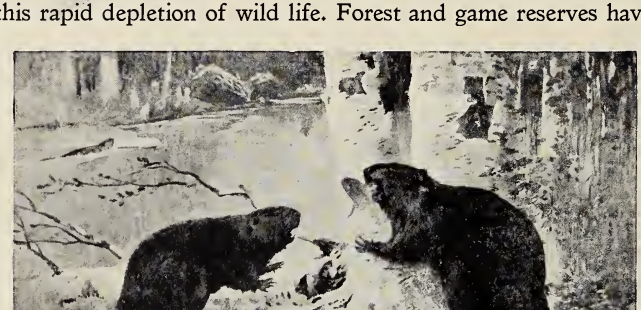
The whaling industry in British Columbia waters is carried on at Naden Harbour and Rose Harbour. Twenty years ago the average catch was over one thousand whales a season, but now it has lessened to about a third of that number. The Norwegians lead in this industry, and Herschel Island is the greatest whaling-station in the world.

44. OUR FUR-BEARING ANIMALS

CANADA owes much to her fur-bearing animals. The first permanent hold on what was afterwards Canadian territory was made by the Hudson Bay Company, whose interest in the country was aroused by tales of the fur-traders. French and British adventurers in search of new fur-fields penetrated our forests and traversed our plains. To the sea-otter we must give the credit of securing for the British our western seaboard; for it was the valuable fur of this animal that attracted

Captain Meares and his colleagues to the Pacific Coast. Another furry pioneer of repute was Old Paddle-tail, the beaver, who blazed the trail of empire across Canada.

To-day the ranks of the fur-bearers, owing to various causes, are sadly thinned. One may paddle over many lakes without sighting a beaver-lodge, and traverse many miles of forest trail without seeing a fox or a rabbit. Fortunately, however, an enlightened Government has taken steps to check this rapid depletion of wild life. Forest and game reserves have



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OLD PADDLE-TAIL, THE BEAVER

been set aside in almost every province of the Dominion, those under federal control comprising a total area of nearly ten thousand square miles, and those under provincial control of much greater extent. Wise laws, such as the North-West Game Act and the Migratory Birds Convention Act, will do much, if properly enforced, to conserve and increase the wild life of Canada.

Many of our most interesting mammals cannot be described as fur-bearers; but the inter-relation of animal life is so intimate and far-reaching that no wilderness creature, however small or large, can be disregarded in tracing the life-histories of our fur-bearers. The abundance or scarcity of mice affects in a marked degree the season's pack of the trapper. It may also

affect his food-supply; for moose, deer and caribou are usually hard to get when mice are scarce. The reason for this is quite simple: when mice are abundant they form the chief food of large carnivores, as well as small; and, unmolested by wolves, the calves and fawns reach maturity in greater numbers during such years. The varying hare is another creature whose relative abundance or scarcity affects the whole circle of woodfolk.

Of the fur-bearers, the beaver is undoubtedly the one that has enjoyed the longest period of popularity. His pelt became the unit of barter at all fur-trading posts. He can well afford

Department of the Interior

MUSKRATS

to rest on the laurels of his past achievements, and enjoy a brief period of immunity from the wiles of the trapper. We are glad to learn that this industrious animal is carrying on his time-honoured activities of lumberjack, mason and engineer, in lakes and streams that for many years had ceased to echo the slap of his tail. As the domestic affairs of this king of rodents are so well known, we shall not discuss them here.

The musquash or muskrat, "little brother to the beaver," has risen from his native mud-banks to occupy a prominent place among the élite of fur-land. True, like many notables (and rogues), he travels under an assumed name; but his entrée into polite society made the adoption of a pseudonym almost imperative. His family life, like that of the fox, is known to most boys, so we shall leave Mr. Muskrat, *alias* Mr. Hudson

Seal, and turn to his less ambitious but highly respectable fellow fur-bearers.

The racoon is not much heard of in these days, except in rural communities, where he has always been a favourite. He affords the farmer's boy and his dog great sport on moonlight nights when the corn is succulent. But as a rule he has his own business to attend to along the stream-side or the shores of the pond, where the crawfish, frogs and young turtles are star-gazing in the shallows. He likes to dine by running water, for he is very fastidious in the matter of cleanliness, and does not relish his food unless it is washed. Because of this habit he is known as Lotor, the Washer.

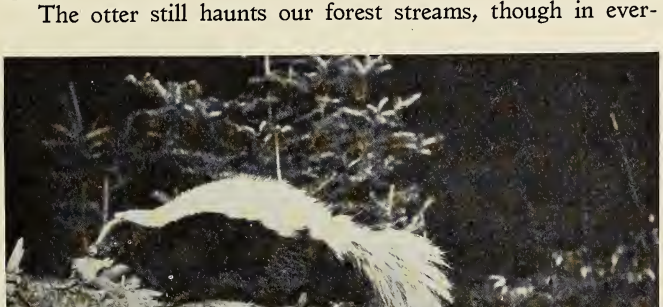
The Canada lynx is one of the carnivores that fluctuates in numbers with the prevalence or scarcity of mice and rabbits, on which he chiefly feeds. Grouse and fawns suffer from his desire for a varied diet. Bobtail is well equipped for hunting in the north woods. His broad feet, well padded above and beneath, make it possible for him to travel with speed and lightness over the deep snows. His tufted ears, heavy jowl and short tail, tipped with black, give him a clownish appearance and make him easy to identify. Though cunning at stalking his prey, he is unsuspicious and easily trapped. Mrs. Bobtail and her kittens, two to five in number, often hunt together, beating the brush for small game such as mice, voles and rabbits.

A sense of humour and playfulness is characteristic of most creatures of the wild. But in only one is that sense of humour diabolical and destructive. The wolverine or carcajou is feared, hated and relentlessly hunted by the trapper, who knows that he might as well quit the woods unless he can rid his trap-line of this marauder. This giant of the weasel family has all the ferocity and ruthless bloodthirstiness of his race, with the size and strength to make them effective. No cache can be so cunningly concealed as to escape detection, nor made so strong as to resist destruction, by this apache of the north woods. The trapper has one thought to console him: when the carcajou's pelt is stretched on the drying-frame, he knows it represents enough money to reward him for his labour and losses.

Next to the wolverine in size, strength and ferocity is the

fisher, the only carnivore that has the courage, dash and audacity to tackle a porcupine—with success. Even his own kind are afraid of him. The marten, to whom he is most nearly related, falls a prey to his superior speed and power; and his own wife is careful to hide her kittens for fear he should make a meal of them. He is as much at home in the tree-tops as the squirrel, whom he pursues from tree to tree with relentless agility.

The otter still haunts our forest streams, though in ever-



Department of the Interior

THE SKUNK

decreasing numbers. His pelt is considered a prize in any bale of furs. Except in the far North, few of these wily creatures are now taken. The man who catches even a glimpse of the otter, passing like a lithe shadow from pool to pool, may consider himself favoured by the deities of wood and stream; and there are few who can boast of having seen a family of otters at play on their "slide."

The weasel in the northern part of his range undergoes a seasonal change in colour, putting off his brown coat for a robe of spotless white, except for the tip of the tail, which is black and serves, no doubt, as a banner to guide his own kind over the snowy wastes. These white vestments, the much-prized ermine of commerce, are donned partly as a protection against

owls and other enemies, and partly to render the wearers invisible to their prey.

Mink, marten and skunks are the other common fur-bearers that help to swell the packs of the trapper. The last of this trio has only in recent years overcome the deep-seated prejudice against his beautiful hide. The stigma has been removed, and skunk-farms are now conducted on a large scale.

45. THE PRESENT FUR TRADE OF CANADA

In the Northland thousands of wild animals each year unwillingly give their lives, because their coats are desired by women for their beauty, comfort and permanence. The skill of the furrier, added to the laborious work of the trapper, provides the costly furs so alluring to the feminine eye. Although the onward march of civilisation has driven the wild creatures into deeper solitudes, yet, because of their scarcity, the price of furs has so enhanced, that in Northern Canada, where the wild animals of America are making their last stand, the fur industry has increased in value at a remarkable rate. In 1850 the value of furs exported from Canada was $93,872; in 1910 it had become $1,927,550, while in 1926 it totalled $17,017,501. Muskrat has now replaced beaver as the most valuable peltry, with mink, fox and sable following. There are 15,000 Indians engaged in trapping, with an equal number of whites and breeds scattered over the great, lone Northland.

The fur in the greatest demand at present is the muskrat, which is used in the making of the black Hudson seal coats and the rough brown muskrat coats, for which there is such a keen demand. The price of a muskrat skin has increased from 35 cents to nearly $2.

The muskrat belongs to the mouse family, but in appearance and habits more closely resembles the beaver. It is a shy little animal, about a foot long, with a naked and scaly tail nearly the length of the body. The hair much resembles that of a beaver, but is shorter, consisting of a thick soft under-fur,

shot with longer, stiff, glistening hairs on the upper surface and sides of the body. The colour is dark brown on the back and grey below. In the banks of rivers and ponds the muskrat tunnels its summer home, whose opening is concealed under the water. There it hides during the day, and ventures forth at night-time to feed on the roots, stems and leaves of water-plants, and on the wild fruits that grow near the river. For winter quarters the muskrat builds in the water, from grasses and sedges, a house of dome-like form, which is plastered over with mud. From the size of the muskrat's water-lodge, the Indians foretell the coldness and length of the winter.

In the latter part of winter, when their fur is best, the muskrats are trapped or speared. Their skins are tanned by the furrier, who has purchased them from the trappers or in the fur-markets of Montreal, Winnipeg, or Vancouver. When the skins return to the furrier, he dyes the short silky pelt a deep black, taking care not to dye the skin, lest it be hardened. It takes from seventy-five to one hundred of these pelts to make a Hudson seal coat. When the raw skins cost nearly two dollars each, it is easily seen that a finished coat will cost the wearer from three hundred to five hundred dollars. Seal coats made from the fur of the Belgian hare are also sold in our stores. When properly matched, the skins of the muskrats, with the fur unplucked, make the beautiful coats so fashionable at present.

The fur trade in Canada has undergone great changes in the past few years. The Hudson Bay Company, which taught the Indians to hunt and trap commercially, no longer has a monopoly of the industry. As the world turns to Canada for a large part of its supply of furs, thousands of Canadians rely for a livelihood upon the fur-bearing animals, either wild or reared on fur-farms, while hundreds of traders deal in the pelts of such animals, and scores of furriers are engaged in tanning, dressing and making up the skins.

In the Northland, a few years ago, each Indian had his own hunting area, surrounded by blazed trees. It required several days, on a journey of fifty or sixty miles, to cover his trap-lines once. His wife at home cleaned and stretched the furs in

readiness for the spring trip to the Hudson Bay trading-post. The trapper was careful not to take too many animals of one kind, lest the supply in future should be exhausted. Then, when the smiling rivers broke the bonds of winter, the Indian and his family loaded their furs into the canoe and started on their long voyage to the mart of the great Company. The squaw would probably hide away some small fur for pin-money, for the Indian would squander a large part of the fruits of his toil for the means of passing a pleasant summer with the other natives at the fort. As long as his small fortune lasted, the Indian gave no thought to the morrow; gambling, feasting and examining toys were sufficient for the day. Traps, ammunition and needful supplies were not thought of until it was time to return home. Then the Company gave each Indian credit for $150, to pay which he was expected to bring in his first catch at Christmas. It speaks volumes for the honesty of the Indians and the standing of the Company, that the debt was always paid without a bill-collector or a follow-up system through the mails.

But the old ways have changed. Forest fires and the zeal of the trapper have led to a great scarcity of fur-bearing animals. The Indian's standard of living has been raised. His wife wants wheat-flour, a gramophone and a photo of the baby, so Running Elk in summer seeks a daily wage near the railroad in getting out posts or railway ties, and does his best at collecting a few fur-pelts in winter, for which he must now have a licence.

The trapping-grounds of those who follow the industry permanently are pushed farther north each year, and are controlled by provincial regulations, which prescribe licences, limit the number of trap-lines and demand their registration, to the great indignation of the Indians. A trapper may have out at one time from fifty to a hundred and fifty traps, which he must visit every few days, and in some provinces every twenty-four hours, to end the suffering of the animals. Care and expert knowledge are required of the fur-dealer at his lonely post. Prices, governed by the world demand, fluctuate from day to day, according to the dictates of fashion. Every pelt is tested

with minute care, for its value is lessened by shot-holes, blood-colouring inside, excessive rubbing, or overheating.

The best fur comes from the far North, where a thick pelt is grown to withstand the intense cold. Furs of the darkest colour are found in the deep-shaded forests, while those in the barren lands of the tundra region are nearly white. The quality of the fur is more important than the colour, for good dyes will give any required shade, but man has not yet found any way of improving the quality of an animal's fur.

When the first signs of spring come, the fur loosens and gradually falls out. In the fall, the new coat is a beautiful, rich, glossy colour, improving in length and density until January or February, when the colour commences to fade as the hair becomes lifeless. When furs are thoroughly prime, all the substance is drawn from the hide to the fur, so that the skin is thin, and when tanned becomes soft and pliable. If the fur is poor, the skin is thick, and has to be shaved down by the furrier, with the danger of cutting the roots of the hairs.

During the Great War, the fur-market of the world changed from London to St. Louis, in the United States, and while this trade is being gradually recovered by England, our greatest market by far is south of the border. When the world market changed to America, Canada developed a share of the trade. In 1920 Montreal became an international fur-market, and in that year sold over five million dollars' worth of skins. Winnipeg, Edmonton and Vancouver are also now important fur-markets.

In the early days of the fur trade, it was the custom for trappers to keep alive the foxes captured in warm weather, until their fur was prime in winter. From this habit has arisen the modern industry of fur-farming. It has a certain future, because the demand for fur is ever increasing, while the supply from the trappers is rapidly diminishing. Canada now has 2130 fox-farms, with a total of 42,125 silver foxes. There are also 210 farms raising chiefly mink, racoons, skunks and muskrats. Great expense is being incurred in building extensive fences over marshy areas for confining muskrats. The value of fur-bearing animals on farms is over ten million dollars, yielding

nearly a million dollars yearly in pelts. Fox-farming on Prince Edward Island has become world-famous, and is also a paying industry on the islands of British Columbia. Mink and muskrats are being reared all over Canada. So important is the industry that a paper like the *Family Herald* has a page for answering questions and supplying information on fur-farming. A pen of muskrats would be valuable property for any boy to own, for the experience that he would gain and the knowledge that he would acquire would be most valuable to him and the profit would be worthy of consideration. Canada is still the world's largest fur preserve. Her early wealth was in the fur trade, and again we are entering an era that bids fair to increase that wealth, not by ruthless slaughter, but by scientific management.

46. FOX-FARMING ON PRINCE EDWARD ISLAND

To-day we are going to visit one of the strangest and most interesting farms in the world. You had better wear running-shoes, for the farmer does not welcome school-children, and he may chase us with a gun. However, if you all promise to be very quiet and not speak above a whisper, he may show us round and tell us about the strange animals he has in charge.

Look on the map for Prince Edward Island, the smallest province in Canada, yet so intensely cultivated that it bears the proud title, " The Garden of the Gulf." We are now ready to visit a silver-fox farm on Savage Island, near the coast.

When we explain the nature of our visit, sightseeing, the farmer takes us to a field fenced off like a ball-park, and about the same size as one. We enter through a gate, which is carefully closed behind us. Before us lies Fox City, laid out like a checkerboard, with streets and alleys and blocks of six wire pens, twenty-five feet by fifty feet and nine feet high. Wire netting extends three feet over the top to prevent the foxes climbing out. We are told that the wire is buried three feet in the ground to keep them from digging a tunnel under the fence. A board

house, with a curious wooden tunnel leading from it, is in the centre of each pen.

Although we do not approach the wire, we notice from four to six foxes in each pen. We are greatly disappointed, for these shaggy-coated animals, with matted fur, surely do not resemble the beautiful silver-fox furs in the furrier's window, bearing the price tag of $1000!

We listen as the guide explains about silver-fox fur.

"In midsummer, the fox, poorly furred, is a sorry sight; for he is growing new hair for the cold winter, and his coat is not really beautiful until December. In any litter of wild red foxes, there may be one black fox, and, once in a very great while, a black fox with a white tip on its tail and a silver sheen to the fur when brushed back. This latter is the famous black silver fox, whose pelt, when dressed, compares with other furs as does the diamond with other precious stones. Some of the first that the fur-trader obtained were tipped in gold and presented to the French king with great ceremony."

"Will the foxes bite?" asks a little girl.

"Certainly they will," says a big girl. "It tells in the History about a noted man in Canada dying from the effects of the bite of a pet fox."

"Who was he?"

"Of that I am not certain, but I am sure it is in the book."

Our guide continues: "The under-fur of a prime silver fox is a dark mouse-colour. Through this thick and silky under-fur grow the longer or guard hairs, which give the pelt its greater beauty, lustre and value. Where they extend beyond the under-fur, the guard hairs turn a deep, rich black. About half an inch from the end, Nature has provided a silvery band of beautiful brilliance, with the hair ending in a black tip."

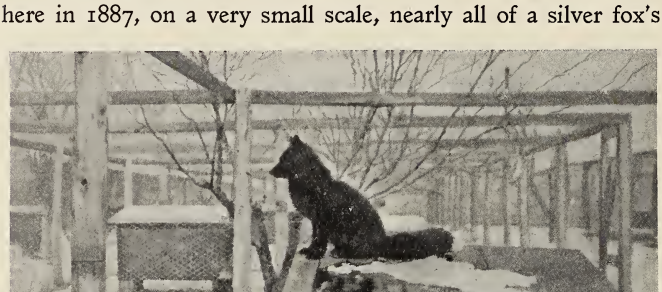
"Are there any little baby foxes here?" asks another child.

"Not in October," the keeper replies. "The puppies are born in early spring, from two to six in a litter. When born, they are blind, have no hair, and are about the size of a kitten. Their eyes open in sixteen days, when the young foxes become very playful. They are weaned when six weeks old, and are left in full charge of the home, the parents being taken to

another pen. These we are looking at are six months old and nearly full grown. Before they are weaned, no strangers are allowed in sight, as the mother becomes very nervous and seeks to hide or destroy her young. Within each house is a smaller house, where she hides the puppies in case of danger."

"Are the young of the silver foxes always the same colour as their parents?"

"No, indeed. When Robert Oulton started the first fox-farm here in 1887, on a very small scale, nearly all of a silver fox's



Department of the Interior

FOX-FARM IN PRINCE EDWARD ISLAND

Notice the tip of the fox's tail. What kind of fox is this?

litter were red foxes, but after twenty generations of silver foxes, the young are usually like the parents. Now a red-headed youngster is a disgrace to its parents, and the whole family would be killed rather than kept for breeding."

"What do you feed them on?" asks a boy, who is already devouring his lunch, although it is only ten o'clock.

"Foxes are fed twice daily, at sunrise and sunset in the summer, and at nine in the morning and four in the afternoon during the winter. The feed consists of beef, mutton, cow's udder, rabbits, fish, vegetables, fruit (when inexpensive), eggs, milk, and breads made of whole grains. The young fox is not fed meat until at least four months old, and the adults do not require it every day.

"The life of the average silver fox is from twelve to fifteen years. The pelts of those more than a year old are best for the market. The price is based on the silkiness of the fur and its thickness and depth."

"Oh, see that big fellow climbing on top of the house!" yells a small boy.

"Yes, they go up there to sleep through the day, or to watch the neighbours, and when night approaches, they become playful and frolic about in the dark."

"Do you think the business of raising silver foxes is bound to grow?" we ask.

"Without a doubt," replies the superintendent. "America spends one hundred million dollars a year for furs. The supply is nearly exhausted as far as the forests are concerned. We must rear these animals to meet the demand."

"Do you sell many live foxes for starting new farms?"

"That has been the most profitable part of the business here," he replied. "Since 1910, the price for a well-bred pair, whose ancestors have been carefully selected for many fox generations, has ranged from four thousand to twenty-five thousand dollars."

"How many foxes have you now on this farm?"

And when we learn that there are over one hundred, we begin to figure with a pencil on the back of an envelope. There are no decimal points in this arithmetic, and fearing that the very kind farmer might charge us at the same rate for the long time devoted to our benefit, we thank him kindly, shake hands, and hastily depart.

47. MANUFACTURING

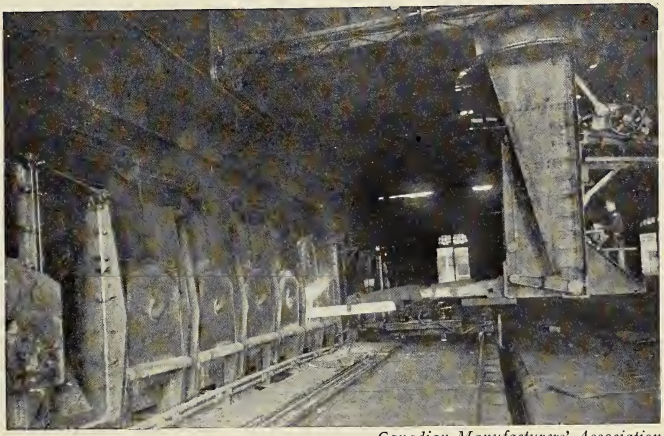
THE history of manufacturing in Canada is one of steady growth, keeping pace with and contributing to the development of the country, but, nevertheless, stimulated by three great causes—the opening of the great West, the replenishment of losses after the Great War, and the present credit system extended to the buying public.

During the first fourteen years of the present century, the building of the Grand Trunk Pacific and the Canadian Northern Railways through to the Pacific created a vast field for labour, and hordes of immigrants each month followed westward to participate in the work, and to settle upon the new lands of the North; while thousands of farmers from the United States, and young men from Eastern Canada, took up farm-lands on the prairie. Goods could hardly be turned out fast enough to supply building needs and to equip the new settlers, so the opening of the West benefited Canada from coast to coast.

For the five years during the Great War the trade of the world was suspended. Each country had to do its best to supply its own needs, and even these had to give first place to the making of war material. When peace came in 1918, the supply of manufactured goods in the country was exhausted, and new factories, created to supply the needs of war, found that, in a day, their market had vanished. The owners had buildings and some machinery that could be remodelled; the returned soldiers were without employment and had to start anew; so, for the next five years, manufacturing in Canada, as in every other country, received a great incentive. But with only nine millions of people to provide for, it became necessary to find additional means of increasing the buying power of the public.

Greater use is now being made of the credit system, which will allow people, earning regularly, to purchase any article, from a door-mat to an automobile, by paying a small amount at the time of purchase and the balance in monthly instalments.

Of course interest is charged for the use of the money, but the difference in the credit price and the cash price is no more than a trade discount. In this way people actually save their money; in fact they must, in order to make the monthly payments. The system has taught many people saving habits, and has given them commodities worth while, when before they simply spent their money in small amounts, with little to show for their labour.



Canadian Manufacturers' Association

STEEL RE-HEATING FURNACES

Algoma Steel Corporation Ltd.

In order to manufacture successfully a country needs raw material for making the goods, power for running the machinery, skilled labourers, capital for establishing plants and financing business until the goods are sold and payment received, a market for the goods, and means of transportation. Ontario, which supplies more than half of the goods manufactured in Canada, has a great future in this industry. Iron, steel and hardwood are the basic raw materials needed for making machinery and the staple articles, such as furniture, tools, and a variety of objects used in a home. With an abundance of

iron ore in the Sault Ste. Marie district, within easy reach of the anthracite coal of Pennsylvania, required for smelting, Ontario produces iron and steel at Sault Ste. Marie, Hamilton, Port Arthur, Deseronto and Midland; while such hardwoods as maple, ash, beech, birch and oak have always been a feature of the province. Formerly steam, produced by coal, was the motive-power in all factories; but hydro-electric power will turn the industrial wheels of the future, and "white coal" from the mighty Niagara is an incalculable asset to the cities of Ontario. This new power supplants the unsightly smoke-stacks and black ruin of coal and smoke, so that a great industrial city to-day may carry on extensive manufactures on her best streets.

Quebec, with immense electric power, is also well adapted for manufacturing, along the whole of the St. Lawrence system; while her people, like those of Ontario, are industrially inclined. Montreal, deriving her power from the Shawinigan Falls on the St. Maurice River, is the greatest manufacturing city in Canada, producing yearly half a billion dollars' worth of goods, consisting of leather and textile goods, cement, tobacco, sugar, machinery, rubber, and iron and steel goods.

Toronto, closely rivalling Montreal in population and manufacturing, produces articles of every variety. A home could be furnished entirely, a farm stocked with implements, and the whole family clothed with goods made in Toronto alone.

Hamilton ranks third in manufacturing in Canada. It is within easy access of the electrical power of Niagara, near the natural gas-fields, and has long been noted for the variety of the goods it produces. In Hamilton were manufactured the first matches made in Canada, the first Canadian threshing-machine, railway-engine, passenger car, freight car, sewing-machine, hand-saw and coal-oil lamp burner. It also produced the first dining-car and sleeping-car in railroad history.

STATISTICS OF TWENTY-FIVE LEADING INDUSTRIES OF CANADA, 1925

Industries	Number of Employees	Capital	Value of Products
	No.	$	$
Pulp and paper	28,931	460,397,772	193,092,937
Flour- and grist-mill products	6,166	60,104,258	187,944,731
Slaughtering and meat-packing	10,709	54,316,043	163,816,810
Sawmills	35,458	204,134,003	134,413,845
Butter and cheese	10,548	37,292,100	124,828,754
Automobiles	12,000c.	74,678,451	110,835,380
Electric light and power	37,000c.	726,721,087	102,587,882
Rubber goods, including footwear	12,926	65,562,734	78,229,574
Cotton yarn and cloth	20,497	83,610,686	72,781,517
Sugar refineries	2,784	50,089,717	68,445,879
Castings and forgings	17,120	84,812,441	61,754,339
Bread and other bakery products	12,438	33,810,441	60,392,439
Electrical apparatus and supplies	14,112	75,375,623	60,158,837
Non-ferrous metal smelting	5,104	61,691,928	56,633,793
Printing and publishing	14,187	48,399,803	53,886,802
Railway rolling-stock	20,202	78,039,179	53,050,665
Petroleum	3,798	50,580,549	50,762,127
Hosiery, knit goods and gloves	14,698	49,350,474	48,555,434
Clothing, women's factory	13,490	21,704,956	46,779,771
Biscuits, confectionery & chew-gum	11,958	40,770,096	46,745,355
Cigars and cigarettes	5,846	30,563,901	41,985,554
Boots and shoes, leather	13,791	30,863,482	40,022,515
Planing-mills, sash and door factories	10,105	48,743,683	40,009,152
Breweries	4,073	51,222,456	38,897,995
Clothing, men's factory	10,818	24,180,348	38,236,384

In glancing at the above list, we see at once that Canada manufactures most of the essential articles that we use. Leaving out pulp, lumber and paper, which are largely sold to the United States, we find that food-products are a main concern, with flour and meat, butter and cheese, sugar and bread as principal items. Clothing, our second need, is provided for, first in the making of cloth and leather, and then in the manufacturing of clothing and shoes. After investing in food and clothing, we spend a large sum for automobiles and gasoline.

Altogether Canada ranks fifth in manufacturing among the nations of the world, producing, in 1926, nearly three billion dollars' worth of goods. This exceeds the value of the agricultural products, and makes manufacturing the most important industry in Canada; but it must be remembered that in this list are included flour and meat, which are already listed in the products of the farm; paper, pulp and timber, which are the main parts of the forest industry; and sugar, rubber and cotton, which are imported in the raw state.

Flour- and Grist-mill Products.—Since bread is the main food of the white race, the people of Canada use nearly one hundred million dollars' worth of flour a year. The hull of the wheat is ground into bran, and the white flour is separated from the coarser dark germ material, which is known as middlings. Bran and middlings are sold as mill feed for poultry, milch-cows, swine and beef-cattle; so that the production of eggs, milk, butter, beef and pork depends very largely upon the by-products of wheat. The first flour-mill in America was established in 1605 at Port Royal by the French, the millstones being turned by a water-wheel. When wheat was ground by millstones, every little settlement contained its flour-mill, but forty years ago the roller or Hungarian process obtained a monopoly, and the industry was consolidated and largely restricted to a few big mills in the main centres of trade. But of the 1310 mills now in operation, over a thousand are country mills. Canada has the largest flour-mill in the British Empire, with a daily capacity of 14,000 barrels, and the flour exported from the country has a value of $70,000,000 annually. In big milling centres, like Kenora, the wheat is cleaned to remove all the foul seed and to polish the berry; it is tempered by dry heat so that the bran can be removed whole; then it is ground by the five breaks system, to split the berry and loosen the middlings, while the grinder samples the thoroughness of his work by touch. The flour is then bolted and sifted to remove the bran and middlings, and is tested for grading, so that the experts, from feeling the flour, can imagine the very appearance and taste of the baked loaf.

Meat-packing.—Years ago the butchers in towns slaughtered

and dressed their own meat; but, with the growth of cities, the slaughtering, curing and packing of meat passed to the city abattoir, where a cold-storage system chills the meat, so that it will keep even when shipped to a great distance. Such products as lard, sausages, smoked meats, bacon and cured hams are prepared in attractive forms for marketing. Large quantities of bacon are shipped to England.

Automobiles.—Nearly one million motor-cars are in use in Canada, and only in three countries, the United States, Great Britain and France, are more cars owned; while, in proportion to population, one car to each ten people, we are second only to the United States. The utility of the automobile has led to its almost universal use. One-half of the cars are owned by farmers; for the automobile brings the outlying farmer near to town. It also enables the majority of the people to enjoy the magnificent scenery that the country affords, and has been the cause of the construction of thousands of miles of splendid highways.

Ninety per cent of the cars in use in Canada have been made in Canadian factories, in 1926 over two hundred thousand being produced. The capital for this industry has been largely furnished by American manufacturers, who have established branch factories in Canada to avoid the heavy duties. Many hundred industrial plants in towns and cities throughout the country supply parts and material for the large factories in Ontario. Altogether nearly twenty-five thousand people contribute to the building of cars, while even more are needed to keep the used cars in repair. The making of automobile tires is a growing industry, although belting, rubbers and raincoats take a share of the forty-six million dollars' worth of imported raw rubber, which, with the labour added, sells in finished form for over seventy-eight million dollars.

Printing.—If one visits a modern printing establishment in any city, he is astounded at the amount of printing that is turned out by shop-work, besides the vast volume of newspaper and periodical publications. Every day brings new ideas that are best expressed to the public by the printed word. The news of yesterday is forgotten to-day, and the business of to-day will

not be so important to-morrow. The modern print-shop prints business cards, handbills, trade names on wrapping-paper, theatre tickets and programmes, church announcements, advertising pamphlets for mailing purposes, headings on stationery and envelopes, ledgers, work-sheets, concert programmes, invitations, announcements, notices, Christmas cards, birthday cards, laundry lists, calendars, and other small articles too numerous to mention.

Type-setting by hand is replaced by the linotype, which is operated by a letter-board similar to a typewriter. When the operator taps an A, the melted and boiling metal in a container is squeezed through an opening and forms the letter in a slot that looks like a keyhole to a Yale lock. The letters of a whole line appear on a slug or bar of metal the length of the line; then a metal arm reaches over, takes the slug and transfers it to its proper place on the other side of the machine.

The modern cylinder press is almost human. It feeds itself from a stack of sheets of new paper, carries a gas-flame for drying each printed sheet, records the number printed, and rings a bell when more paper is required. More delicate work can be done by machinery with the advent of the electric dynamo, which is easier to control than steam-power, is more regular, and may be so adjusted as to exert the least possible force.

Leather and Shoes.—Tanning hides started in Canada more than two hundred and fifty years ago. In the early days the pioneers took their hides to the tanner, brought home the leather, and waited for the journeyman cobbler to come and make shoes for the family, and, if the tannery were not within convenient distance, the tanning was done at home. Supplying hemlock-bark for the tanneries was an important source of revenue to many a Quebec and Ontario farm. Though the supply of hemlock-bark has decreased and chemicals have been substituted, vegetable tanning is still the more important process. Among the modern vegetable substitutes for hemlock- and oak-bark are the acorn of the evergreen oak of the Levant, the Sicilian sumac, and the dried fruit of an Indian tree.

In the chemical process known as chrome tanning, the hair is dressed from the hide, which is pickled in sulphuric acid

and sodium chloride, and then placed in a solution of chromium sulphate. When the hide is saturated with the chemical, it is known as chrome leather, which is tested by being boiled for five minutes in water; if the skin does not then curl, it is considered to be properly tanned. Chrome tanning requires less time than bark tanning, which takes six months or longer, but the leather from the chemical process is not so durable, and shoes made from it do not keep their shape, but respond to humidity in the atmosphere.

The demand for leather increased when horses took the place of oxen for working purposes, and elaborate leather harnesses came into general use. The demand for some kind of leather for trunks, bags and automobile upholstering led to the use of artificial leather, which is made either on a backing of linen, cotton, or jute fibre, or by drying oils and chemicals. But real leather will always be used for shoes, harnesses and belting.

The value of the leather tanned yearly in Canada is over twenty-six million dollars. There are 104 tanneries in the country, and Ontario yields 85 per cent of the output.

Last year Canada produced twelve million pairs of boots and shoes, which would provide two pairs a year for each person in the country. All the shoes needed by Canadians could be produced by the factories in seven months; for less walking is done since the automobile has come into general use. The trade is also affected by large numbers of American shoes, known as distress goods, being placed on the market for sometimes less than half-price, when the fashion has suddenly changed in that country. Also British shoes enter the country under the low preferential tariff, and command a wide sale.

Women spend far more money on shoes than men do, buying from four to five times as many and paying nearly double the price, because of the changing styles; for the renewing of lasts and patterns adds greatly to the cost of production. A noted change in the style for men, as well as for women, is the wearing of low shoes.

Farm Machinery.—Ontario is one of the most important

places in the world for the manufacturing of farm machinery, because she has iron, hardwood, and a plenteous market in the West, and she sells her products even as far as South Africa. But farm machinery, when properly housed, lasts a long time; so the country now spends more on shoes or stockings than on these implements. Often a demand is created by newer types of machinery, as the gasoline tractor and the new reaper, which, attached to the tractor, cuts the wheat, threshes and sacks it, as it travels over the field.

As Canada increases her output of goods, expensive machinery for manufacturing, which is now largely imported from the United States or from England, will be produced in our own country.

Furniture.—With a great wealth of hardwood, Ontario has produced at Toronto and adjoining cities most of the furniture used in Canada. The amount manufactured at present does not place the making of furniture among the twenty-five leading industries for two main reasons: one, that furniture lasts for a lifetime, and once supplied, a family buys little more; and the other, that people at present are spending so much money on automobiles, and so much time in them, they are not much concerned about furniture. Cases are known where the piano has been sold to make the first payment on a motor-car.

In the making of furniture there are machines to cut the wood into desired lengths and sizes, dowelling and grooving where necessary, and shaping the parts all ready to be put together. They then go to the cabinet department on the next floor, to be assembled. All joints are carefully fitted, glued and corner-blocked, rigid and strong. Some of these pieces, of course, are clear native hardwood. Then there are the veneered imported hardwoods. The veneer is in big flat sheets cut from around the log, showing a beautiful grain. A bureau, for example, is built with walnut veneer, the veneer being dipped into a strong glue and applied cross-grained to the flat surfaces, making it doubly durable. Your school seats, too, are made in this factory—some of the plain hardwood, and the newer and more durable kind of five-ply veneered hardwood.

The furniture now goes to the third floor to be finished. There are many finishes, light and dark, walnut, or French and creamy enamels. Each has its own particular method. Applying the varnish is a very interesting process. There is a big three-walled compartment with a powerful electric fan at the back to draw off the fumes of the varnish. The piece of furniture is placed on a stand in this compartment, and the varnish sprayed on. The varnish and a stream of compressed air pass through separate tubing, and meet in the nozzle of the sprayer, forcing the varnish out in a fine clean spray that quickly and evenly covers the article. After this has dried, the article is rubbed and polished to the fine finish we see on the furniture in our homes or in the store windows.

The Manufacture of Cotton.—No other plant is of such value to man as cotton. Its home is in Asia, where it was known and used long before the time of Christ. It has been introduced into both North and South America, and the largest part of the world's crop is grown in the Southern States of America, although it is produced in any part of the Torrid Zone where good soil and plenty of moisture are found. Egypt, British Sudan, India and Peru are all now important cotton countries.

Manchester, England, is the leading cotton city of the world; for it is here that the raw fibre from the Southern States, Egypt and India is made into the many varieties of finished cloth that are sold around the world. Cotton is used by all people except the Eskimos. In hot lands the savages must have their yearly wardrobe, consisting of a few yards of cotton, paid for in copra, gold-dust or feathers. In the colder parts of China the natives, instead of buying fuel, add extra cotton clothing, so that a person thin in summer may look very stout in winter.

The Mississippi Valley, fronting on the Gulf of Mexico, would be the nearest cotton district for us to visit. In the days of slavery the cotton plantation was a very picturesque sight. The fine colonial mansion of the southern gentleman and slave-owner stood near the river—for all transportation was by water in the early days. The house was usually painted white, with huge columns in front. Behind the house were the

cabins of the slaves—negroes brought from Africa to toil in the cotton-fields.

The negroes still drive the mule-teams at the plough, and the women and children pick the cotton, but now they work for wages, and the owners are poorer than those in the days of slavery. The land is ploughed in February, and the cotton-seed planted in March. Ten days after the seeds are planted the shoots appear above the ground. The plants are thinned out to the distance of a foot apart, and the weeds are carefully checked. The leaves of the cotton-plant look much like those of the maple.

When the plants are over a foot high little square buds appear, which soon break out into beautiful white blossoms. In a few days the petals, having turned from white to rose, drop off, and a tiny green boll is left on the stalk. In less than two months the bolls are the size of hens' eggs, and then they break open, splitting three ways, and the fluffy white cotton, like a Santa Claus' beard, gracefully waves in the breeze. There is no more beautiful sight in the world than to look out over a cotton-field and see the coloured people, the cotton-pickers, busy at their work, picking off the bolls. The raw cotton is packed into bales, and shipped to the cotton-mills, where it goes through the ginning process, which separates the seeds from the fibre. It is then tightly baled by hydraulic pressure, covered with coarse jute bagging, and shipped to the spinning and weaving-mills in Canada and other countries.

From cotton are made thread, muslin, cambric, canvas, duck, calico, cheese-cloth, lawn, mull, madras, print cloth, twills, sateen, denim, and different kinds of dress goods. The seeds were formerly destroyed, but now are of great value for making oil and meal. From the oil the Dutch make butter; the Italians, a substitute for olive oil; and the French, soap. Sardines are packed in cotton-seed oil, and miners use it in their lamps. Cotton-seed meal is fed to dairy cows in Canada, and aids greatly in the production of milk. From cotton-stalks an artificial silk is made. The lint that clings to the cotton-seed is also used to make wrapping-twine, lamp-wicks, and padding for mattresses and cushions.

But cotton has its insect enemies. The boll-weevil bids fair to ruin the cotton industry, unless some enemy of the insect is speedily discovered to destroy it.

Eastern Canada imports raw cotton from the Southern States, and manufactures cotton textiles to the value of $70,000,000 annually. Three-quarters of this amount are produced in the St. Lawrence Valley, while Yarmouth, Nova Scotia, has the biggest cotton-loom in the world; and Marysville, New Brunswick, has one of the largest cotton-mills in Canada. A new product of the trade is the making of paper-mill felt, which carries the wet pulp through the drying process. The products of the Canadian mills find a large market in Canada, and are also exported to the West Indies, South America, New Zealand and South Africa. Keen competition is experienced from English cotton goods, which have an advantage because of the British preferential tariff.

The two main processes in the making of cotton cloth are the spinning of the fibre into yarn or thread and the weaving of the thread into cloth. When the pressed fibre is received, it is first put into a hopper to be fluffed up, after having been baled under great pressure to save space in shipping, and to have the dirt and stray leaves removed. It next goes through the opening and picking machines, to further clean and separate it. The carding machines are huge rotating cylinders, containing wire teeth, which draw out the fibres until they lie parallel. The next process is to join the fibres into yarn, which is not difficult, because they have a natural twist, and is accomplished by rolling the material and passing it through a funnel. The yarn is then wound in bobbins and taken to the loom, where the warp threads and the weft threads, placed at right angles to each other, are drawn by swift machinery over and under each other, and gathered into cloth. The great cotton looms of to-day are the results of the patient efforts of inventors during the past hundred years.

Sugar-refining.—The amount of raw sugar brought into Canada exceeds that of any other import, amounting to over a billion pounds a year. After the home market is supplied, a large amount of refined sugar is shipped to

Europe, South America, and even to the West Indies, where it is grown.

The human system craves sugar, as it is a carbohydrate, or heat and energy producing food in the most palatable form. Early man satisfied his cravings for this delectable food by robbing the wild bees of their winter supply of honey. Sugar-cane, from which we derive most of our sugar, was probably first cultivated in India. The art of refining sugar was developed by the Arabs, but it was produced, in the early centuries, in such small quantities that it was a luxury indeed, selling for several dollars a pound. In the Middle Ages, Venice was the centre of the sugar trade, supplying England with the article in return for wool. The Spaniards introduced sugar-growing in the West Indies; and, when tea came and coffee became commonly used, larger quantities of sugar were raised to supply the greater demand caused by the drinking of these beverages.

Canada imports raw sugar largely from the West Indies and the Fiji Islands. The sugar is crushed under a great pressure in mills near the plantations, and the juice is boiled down until it forms crystals, the thick syrup not crystallising being sold as molasses. At St. John, Dartmouth, Montreal and Vancouver, large sugar refineries are established, which extract the impurities from the brown crystals of sugar, and turn it out in white, granulated form for table use.

The crystals of sugar, in being refined, pass through three main processes. First they are placed in steel baskets lined with copper cloth, where, mixed with the washings of sugar, they are rotated rapidly, and then washed with water to carry off the impurities. The washed sugar is next treated with lime and phosphoric acid, which, without affecting the sugar, precipitate the impurities into solid form, so that they can be removed when the solution of sugar is strained. The liquid, still brownish in colour, is filtered in steel cylinders containing bone char, which is charcoal made from the bones of animals. After being repeatedly filtered with this substance, until all the impurities are removed, the liquid is boiled until it crystallises. The syrup which remains on the crystals is washed off

and sold as treacle. Having passed through so many processes, sugar is one of the cleanest foods we eat.

Beet sugar is harder to refine than cane sugar, but, as the acreage of sugar-beets in Canada is increasing, the refining of this sugar will become an important industry.

48. CANADA'S WOOLLEN INDUSTRY

With the exception of the people who live in the tropics, everybody in the world has always been wholly or partly dependent for clothing on wool, which is the thick wavy covering of the sheep. Although everybody in Canada wears clothing made from wool, it is amazing how little even so-called well-educated people know about wool or how wool is made into clothing.

You have all read in the Bible about the shepherd kings of Israel, and you therefore know that the raising of sheep for the purpose of providing clothing and food is a very ancient industry. Indeed, the use of wool for clothing goes back to where the misty curtain of time hides both the history of sheep and the history of mankind.

We know that cotton, a vegetable fibre obtained from the pod of the cotton-plant, was woven into cloth 3500 years ago. Linen, produced from the plant known as flax, was woven into cloth in Egypt at an even earlier date. Silk, from the cocoon inside of which the silkworm transforms itself into a butterfly, was woven in China five thousand years ago, in the days of Fu-hi, whose royal queen, according to legend, personally tended silkworms, inventing the methods of spinning and weaving the fibre, so that there might be an additional source of employment for her people.

But wool, and the use of wool for clothing, is of even older origin than any of these, and the reason is easy to see. If you take fibres of wool and twist them together in your fingers you find that you can make a thread, and there is little doubt that in this primitive way the earliest mothers of our race,

sitting at the doors of their caves, surrounded by their children, and awaiting the return of the father and elder boys from the hunt, made woollen yarn which they afterwards wove into cloth.

Canada is essentially a wool country. We cannot grow cotton in Canada, we cannot produce silk, but we can grow sheep and produce wool. It is the one textile fibre we can grow to advantage, and it is the textile fibre that we need the most.

Scientists tell us that the prehistoric sheep roaming the continents of Asia and Africa were black or brown, and grew an overcoat of long and coarse hair to protect the soft white wool that grew next to their skins. It will be interesting to follow through the history of one breed of sheep, the merino. The ancient Romans were the first people to carry the care of sheep to a fine art. They were a luxury-loving people, and the best was none too good for them. The noble Romans had private sheep-ranches in the mountains of Italy, where they grew the wool that was woven into their togas. To keep out dirt and moisture their sheep were dressed in overcoats, made from the skins of wild beasts, and slaves were kept busy removing the coats and combing out the wool to prevent matting. Four times a year the sheep were bathed in fine olive oil or wine. To this kind of treatment they responded by producing fine wool.

About the year A.D. 700 the Moors invaded Spain, and while on their way there, they obtained large flocks of the fine Roman sheep. These sheep brought up the standard of the native Spanish sheep to such a pitch that, when the Moors began to manufacture wool, they produced the best cloth then made in the world. The proud city of Seville was built up by the woollen trade. Then the Spanish rebelled and ejected the Moors, and banished the wool-workers and their families to the number of about a million. The glory of Seville was gone for ever, and Spain as an industrial nation started on the downward path.

In the seventeenth century Colbert, that great French patriot, shrewd and far-seeing, the adviser of Louis XIV. of France, realising that no country could prosper unless it grew

its own raw materials for clothing and manufactured it within its own borders, had his monarch ask the King of Spain for a flock of the fine sheep. He received them, and they were such a great success that Norway, Sweden, Denmark, Prussia, Saxony, Hungary, Hanover, England, and finally Australia and Canada, obtained flocks. The special sheep whose history we have been outlining are known as "merinos"; but there are some two hundred different kinds of sheep in the twenty-two countries in the world which are producing wool at present.

Canada is a fine sheep country, and we can rear successfully every type of sheep, including merino. Sheep-breeding in Canada is economically sound, because the flocks do not have to endure droughts, which occur in other sheep-breeding countries, or to suffer from the diseases to which sheep in Great Britain are too often subject. Sheep fit into the business of mixed farming as no other farm animal does, and the raising of sheep in Canada is directly connected with successful farming. There should be a flock of sheep on each Canadian farm. That good sheep are grown in Canada is shown by the fact that at the greatest show of live stock in the world, the Chicago International Stock Show, sheep bred in Canada swept the boards of prizes last year. This proves Canadian sheep are right, the wool is right, and our country is right.

You have all been to the Canadian National Exhibition on Children's Day. On the largest record day there were 230,000 humans on the grounds. You can get some idea of the number of sheep in Canada if you realise that there are ten times more sheep in Canada than there were human beings on the grounds of the Exhibition that day. Yet we have too few sheep in Canada for the good of the country. In Great Britain, which is very small as compared to Canada, there are to-day ten times the number of sheep that there are in Canada.

The wools produced in Canada, grade for grade, are as good as those produced in other countries; and Canadian mutton and lamb are second to none in quality and flavour for table use. But it is not only necessary to grow good wool, it is also necessary to divide the wool up into its various grades, so that the manufacturer can buy exactly what he requires.

To the layman wool is just wool, but to the wool manufacturer the kinds of wool are of infinite variety. Wools have just as marked differences to the woollen manufacturer as bricks, timber, stone and cement blocks have to the builder. In Australia alone the Government graded the wool produced there into over eight hundred different qualities. The manufacturer of wool has to buy the exact grade of wool he requires to make the kind of finished fabric he desires, and the wool may range all the way in price from twenty cents a pound to ninety cents a pound.

If a builder wanted to buy red bricks to build a red-brick house, and the brick-maker sent him a mixed lot of yellow bricks, field stones and cement blocks, he would quite justly refuse to take the shipment, because it could not be used for the purpose. In the same way the manufacturer of woollens wants the exact kind of wool he is going to use. Before sale to the manufacturer Canadian wool is now graded by the sheep-growers' own organisation, known as the Canadian Co-operative Wool Growers' Association; and as a result the farmers get better prices for their wool, and it is earning a high reputation.

When placed under a microscope a single fibre of wool is seen to consist of three distinct parts. First is the epidermis, an outside skin, which is made up of a series of scales lying one upon the other. These scales, or serrations, having saw-toothed edges, interlock with the scales on the other wool fibres, and thus give the wool its spinning and its felting properties. Second comes the cortes, or the middle of the fibre. And third comes the medulla, or pith of the fibre. Wool is one of the most elastic of the textile fibres, and possesses fairly good strength.

Wools may be roughly divided into three classes: clothing wools, combing wools, and carpet wools. Clothing wools are the large group of wools suitable for use in making fabrics on the woollen system, such as tweeds, blankets, woollen stockings, and so on. Combing wools are the wools suitable for use in making fabrics on the worsted system, such as serges, cashmere stockings, and so on. Carpet wools, as the name signifies, are used in making floor-coverings. Roughly speaking, clothing

wools are obtained from cross-bred sheep and combing wools from merino sheep.

The manufacture of wool into clothing is one of the first industries of Canada. When the earliest French pioneers came to Canada in sailing-ships some three hundred years ago, they brought sheep with them, together with spinning-wheels and weaving-looms, and started the wool-growing and woollen industry in our country.

While conquering the wilderness for us they made their own clothing, and it remained more or less of a household industry in Canada, as it did in other parts of the world, until the introduction of power machinery in the early days of the eighteenth century. In 1827 there were actually some five hundred woollen mills in Canada. Our population being mainly French and British, and being close to the United States, the best methods of all countries were adopted in producing woollens.

To-day the woollen and knitting branch of the textile industry in Canada has 294 mills, with a capital of $88,000,000, and employs 23,645 hands. It is a Canadian industry, since 94·4% of the capital is Canadian.

There is no climatic, technical or physical reason why all the woollens and knit goods we require should not be made in Canada. The spinning atmosphere is favourable, the water is suitable, and the workers are intelligent. We have mills with modern machinery equal to any mills in the world.

It is, of course, only possible to give the merest outline of wool and its manufacture. Wool, as it is clipped from the back of the sheep, is full of natural oil and acquired sand, dust, dirt and vegetable matter. Wool in this state is known as "in the grease," and if you looked at different grades of wool in this state, you would marvel at the skill and patience of those who turn this unattractive substance into fabrics of great beauty and fineness of texture.

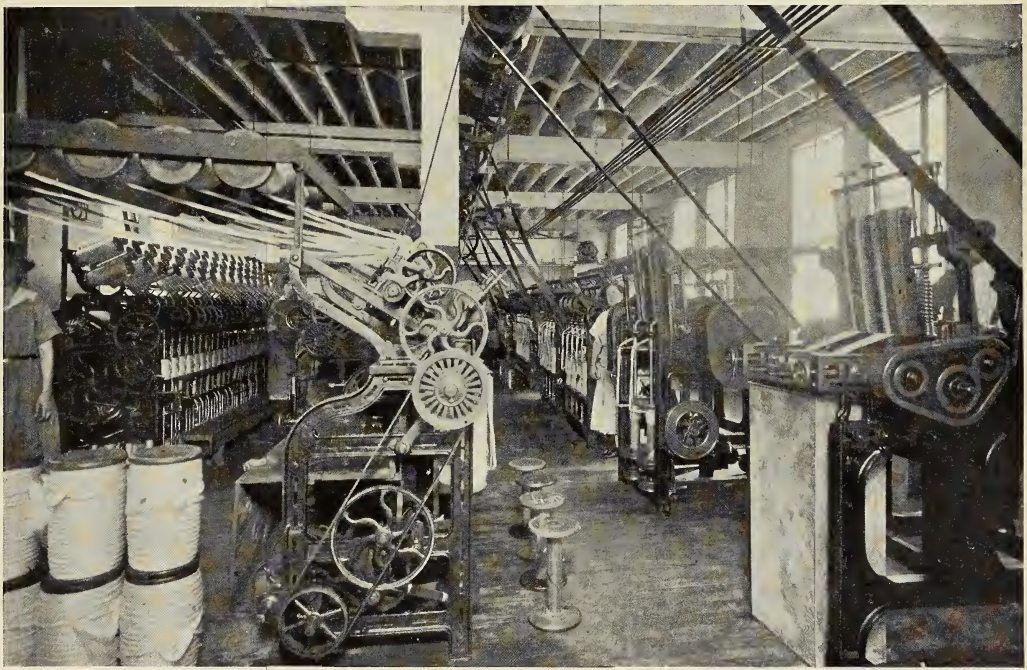
When wool is bought in the grease by the mill it is usually already graded, that is, it is roughly all one kind of wool. But this graded wool is gone over and again divided more accurately into different kinds: this is known as sorting.

Before the wool can be used the dirt and grease must be scoured out, and this work is done in huge, long steel tanks containing soapy water, through which the wool is made to pass by machinery. It goes in dirty at one end, and comes out clean at the other. As the grease and dirt are left behind in the water, the weight of the wool which comes out is only about one-half of the weight of the wool that goes in. As it is the clean wool which finally is sold by the mill in the fabrics it makes, it is the cost of the clean wool which is important. For instance, if a mill pays 50 cents for a pound of wool in the grease, which when scoured loses half of its weight, the mill has actually paid $1 a pound for the clean wool, and in addition there is the cost of scouring. This makes it very confusing in understanding the prices of wool, as quotations read in the newspapers are usually for wool in the grease.

Let us now follow the woollen system through to manufacture.

After the scoured clothing wool has been passed through a dryer it is taken to the carding-room. Here are huge machines, as big as a locomotive and as expensive, known as "cards," which consist of a number of large rollers covered with thousands of wire teeth. As the wool passes over these rollers the teeth separate the wool fibres one from the other, and when they reach the last roller an arm working up and down takes the now light and fluffy wool from the wire teeth. It comes out from this machine in a long soft rope. The wool fibres are mixed all higgledy-piggledy in this rope. If you have dumped a box of jack straws on a table you will have some idea how the wool fibres are jumbled together. This rope is then put through another machine, which reduces it in size to about the diameter of a lead pencil, and it is now known as roving. This roving is then taken to a spinning-mule, which draws it out and twists it at the same time. The twisting gives it strength. The yarn produced in this way is woollen yarn, and the jumbled wool fibres give the characteristic soft and rough finish to tweeds, blankets, woollen stockings and woollen sweaters.

On the other hand, when combing wool is to be manufactured on the worsted system after being scoured and carded,



Canadian Manufacturers' Association

MILTON WORSTED SPINNING-MILLS

it is passed into a machine called the "comb." The comb draws all the wool fibres parallel to each other, just in the same way as human hair may be straightened with a hand comb. When the wool fibres come from the comb they are all lying parallel like sardines in a tin. The wool comes from the comb in a long soft rope, known as a "top," and this rope is taken to a spinning-frame, where it is drawn out and twisted into yarn. The yarn produced in this way is known as worsted yarn, and gives the characteristic hard and smooth finish to worsted fabrics, such as serges, cashmere stockings, worsted sweaters, and so on.

A description of weaving, knitting, dyeing and finishing must wait for another time.

In conclusion: while wool has not the manifold usability of cotton, the polished fineness of linen, or the sheen of silk, it occupies first place among fibres for textile manufacturing, because, while the structure of the wool fibre lends itself to fabrication, its beauties can only be brought out by the highest skill combined with knowledge. To obtain fabrics of beauty from wool it is necessary that those who work it shall have an affection for wool. To-day, in Canada, fabrics of wool are produced in an endless variety and of great beauty and fineness of texture, and the ordinary man and woman wear fabrics of wool which would have been beyond the means of kings and queens not so long ago. The wool-growing and wool-working industries are vital to Canada, because they supply employment both to agricultural and industrial workers through the long winter months, as well as during the summer, and to women as well as to men. Sixty per cent of the mills are in rural centres of under ten thousand population, so that the continuance and building up of the industries are vital to the life of the rural towns in Canada.

49. THE RUBBER INDUSTRY OF CANADA

RUBBER has not yet arrived at the second centennial of its discovery, and has been in practical use only 156 years. Nelson's *Encyclopædia* says it was first brought to Europe in 1735. Thirty-five years later man found that it could rub out pencil marks. Thus its first use and name were established, and although to-day rubber has many other uses, it still keeps the name gained by this first operation.

Thirty more years elapsed before further use was made of rubber, and this time the waterproof coat, commonly called "Macintosh," after its inventor, was developed.

The industry as we know it to-day owes its existence to Charles Goodyear, who is credited with the discovery of the vulcanising process. This method of hardening rubber made enormous developments possible, but these took time, as the process had to be adapted to many different uses.

Buggies and wagons were first equipped with solid rubber tires shortly before 1870, and the inflated tire appeared soon after. Then followed many other commercial and industrial uses for rubber. Drug sundries, such as hot-water bottles, atomisers and the like, were first manufactured about 1860, but the commercial production of raincoats for men and women did not get really under way until about 1885.

Of course you all know that rubber, in the form of "latex," is the sap of the rubber-tree, and your classes in geography have shown you that it is tapped in almost the same way in which the sap is obtained from a maple-tree in our own Canada. When this sap has been collected, it is cured either by smoke or by acetic-acid treatment, and is shipped in sheets to rubber factories.

Before we go into a brief description of manufacturing processes in the rubber industry, the story of how Goodyear discovered the process of vulcanising might interest you. Actually there are many stories of trials and disappointments, with, behind all, an undercurrent of indomitable bravery. The

story most generally accepted as correct is one that tells of Charles Goodyear's decision to try to find a method of preparing rubber. Rubber companies were in existence, but they had found that in the heat of summer the goods made in wintertime had melted. Goodyear, loyally supported by his wife, commenced a long series of experiments. Frequently he was on the verge of success, and once, so certain was he, he made a book of rubber sheets, and wrote the history of his invention. Alas! when summer came the pages became soft, and later brittle. Every cent the family could spare went to buy rubber. Mrs. Goodyear pawned the last of her trinkets, even the bed-linen went to the landlord in payment of the rent, and the children sold their school-books to buy more rubber.

Then clouds showed their silver lining. One day, as he was kneading a mixture of rubber and sulphur in front of the stove, Goodyear, waving his hand to emphasise his remarks, hit the stove and dropped the mixture. It did not melt, it only charred —and he was on the road to success. Although the goal was in sight, many years elapsed before the final process was perfected and Mrs. Goodyear's faith in her husband was justified.

Made possible by these heroic sacrifices, rubber to-day plays an important rôle. Tires, footwear, clothing, drug sundries and mechanical goods of many kinds are made from it, and in the rubber industry and the others allied to it many thousands of Canadian workers are employed.

Since there is not time to describe all the industries, suppose we take a trip through a tire-factory.

We enter at the ground level, stepping across the rails on which car-loads of crude rubber stand waiting to be unloaded. Inside the door we can see stacks of white crepe-like rubber (this is acid-cured), more stacks of smoky-brown, and a heap of lumps of black rubber in the shape of hams. These "hams" are Para rubber cured by natives, who revolved them, gradually increasing in size, on sticks in the smoke of a fire. The stacks are composed of cubes of sheet rubber, still in the shape of the boxes in which they travelled. Men in overalls are tearing off layers with hooks. On the next floor are the washing-machines, very like the electric washers we have in our homes, and here

the sheets of rubber are being cleaned before they go to the compound-room.

It is in this compound-room that the company's secrets are kept. Chemists add certain quantities of different materials to specified amounts of different kinds of rubber, which are put in what are known as batch-cans; these batches are then carried to the rubber-mills for mixing.

The rubber-mill has a pair of heated rollers, around which the batch revolves. As the mixture is compressed between these rollers the many ingredients are kneaded together, just as Goodyear kneaded and rolled his experimental batches with his wife's rolling-pin. When air-pockets form in the batch there are loud explosions as the rollers force the air out.

Now we must leave rubber for a moment to step into the textile department, where they are inspecting the rolls of duck and cord fabric that have been shipped from the cotton-mills. Here there are rolls of fabric done up in burlap, which are being opened and tested. Every inch of the fabric is tested on a table of plate glass with lights beneath, and occasional samples are snipped out to be tested for tensile strength and twist on delicate instruments. The tire-factory specifies when ordering cord or fabric that it must have a certain minimum breaking-strain, and it has instruments which will check this strain, and record the stress under which it breaks.

Great care is taken to see that conditions in this testing-room are right. Cotton is manufactured in air containing six degrees of moisture, and, hissing away in one corner of the testing-room, is an instrument that is reproducing that humidity here.

"What are those scales for?" you ask the expert, and are told that they are to check the moisture in the cotton. A thread is weighed, then thoroughly dried in a special oven. Then it is weighed again, and the difference in weight of course represents the percentage of moisture.

Now we take quite a long walk over to another section of the factory to see the calendar mill. This enormous machine is a series of three double rollers, which force the rubber into every crevice in the fabric. The first pair of rollers treats one

side, the second pair rubber-coats the other side, and the third puts a smooth coat on top of the first.

Up a flight of stairs, and we come to the bias-cutter. This oversized guillotine cuts the fabric on the bias (the girls will understand what that means), so that the cords in the fabric run at an angle and give greater strength. On this same floor we see men making the "beads" which hold the tire on the rims, and then, after another long walk, we reach the tire-builders.

These men, working on cast-iron moulds, build up the outer covers layer by layer, following the special needs of the particular job; and from them the completed case goes to the curing-room to be vulcanised. This room, to save time, is located not far from the builders, and it takes only a few seconds to get there.

Here, amid roars of compressed air and jets of escaping steam, lightly clad men are working at top speed. They are placing the newly built covers in moulds, inserting air-bags to inflate them, clamping down the cast-iron moulds and lowering them into the pits. In these heated pits a combination of steam heat, air pressure and hydraulic pressure welds the various parts into finished tires.

Over in a far corner we see a group of men making a final inspection of the tires before they are shipped out to motor manufacturers and dealers. This last inspection is about the six-hundredth from the time rubber and cotton leave the plants on which they grow.

While the moulds differ in shape, and fabric does not play so important a part, the manufacture of other rubber products follows in a general way the processes we have just seen during our long trip through the factory.

In Canada rubber is the most important thing in the lives of eleven thousand wage-earners in rubber-factories, and many more in the industries which supply important necessities to them. From Canadian factories, mines, quarries and refineries the rubber industry obtains glue, paraffin, petroleum, benzol, mica, talc, soapstone, asbestos, lead litharge, cotton, duck, cord fabric, shoe-moulds, tire-moulds, moulds for mechanical

rubber goods, and a limited amount of barytes, just to mention a few products.

$56,160,900 is invested in the thirty-eight factories of Canada, and each year $11,413,600 find their way into the pockets of Canadian wage-earners. The manufacture of rubber calls for workers of high intelligence. Most of the operations require skill, and the earning-power of a trained rubber-worker compares very favourably with that of workers in other industries. Chemical and textile studies are of assistance to those who wish to get ahead in the industry, but above all—and this is true of any job you undertake—the greatest asset is ability and willingness to work hard.

50. THE MANUFACTURE OF PULP AND PAPER

The manufacture of pulp and paper in Canada, owing to her vast natural resources in forests and water-power, has assumed the proportions of a major industry. In the production of news-print she leads the world: and as the making of news-print involves the chief processes of the pulp and paper industry in its various branches, we shall select for purposes of description a plant that specialises in the production of that commodity.

In Eastern Canada pulpwood is usually brought to the mill in short logs of small diameter; but in British Columbia logs from one to four feet in diameter and forty feet long must be handled. These logs, consisting of hemlock, spruce and true fir, are brought to the mill either in flat booms or in huge cribs, known as Kelly rafts. They are drawn from the water by the usual sawmill conveyor, placed on the log-stop and loader, shifted to the saw-carriage by means of steel log-lifts, and fed to band-saws, which remove the slabs and leave squared timber. Both slabs and squared timber are carried forward on roller-conveyors to edgers, that rip the oversize pieces into cants approximately eight inches square. Chain-conveyors carry the slabs and cants to the slasher-saws, a series of circular saws, spaced thirty-two inches apart, revolving on a common shaft, by means of which the long pieces are cut into bolts.

The bolts that are free from bark are conveyed by flume direct to the chippers or grinders; but those to which any bark adheres, which is usually the case with the slabs, are sent by a separate flume to the barkers.

The barkers are large hollow cylinders made of structural steel, with their axles lower at one end than the other. The blocks are fed to the cylinders at the higher end, are tumbled and jostled about as the cylinder revolves, and their contact with each other and with the steel bars of the barker abrades

Canadian Manufacturers' Association

PILES OF PULPWOOD

Plant of E. B. Eddy Co. Ltd.

or rubs off the bark. By the time the bolts arrive at the lower end of the cylinder they are usually clean. The pieces of bark fall through openings in the wall of the cylinder and are conveyed, along with knots, sawdust and other refuse, to the boiler-room, where they are used for fuel in the production of steam.

When the bolts leave the barkers they are conveyed by flume either to the grinders or the chippers, according to whether they are to be made into groundwood pulp or sulphite. On their way they are inspected, and pieces having bark adhering to them are picked out and thrown into side conveyors, that carry them to hand barking-machines. The hand barkers

may be revolving cylinders or disks, carrying knives, against which the bolts are pressed by hand until the bark is removed.

In the case of bolts destined for groundwood pulp, they are fed into the grinders. Each grinder consists of a cast-iron housing containing pockets into which the bolts are placed, to be ground into pulp, and the pulpstone, which accomplishes the grinding. Over each pocket is a cylinder, operating a pressure piston by hydraulic action. When the pocket is filled with bolts the piston presses them against the revolving stone. Water is sprayed on the stone to reduce the frictional heat, and to wash off the pulp. To keep the stones with a good cutting-face, an automatic device for scoring the surface is included in the housing. Made of natural sandstone, the pulpstones are produced in various parts of Canada. They vary in size, but usually run about fifty-three inches in diameter and from three to four feet wide.

After leaving the grinders the pulp is diluted with water, and run through screens for the purpose of removing refractory material. The rejected material is not lost, but is re-ground and re-screened, to be mixed with a certain amount of sulphite pulp and made into coarse wrapping-paper. The groundwood that passes through the screens goes to the "deckers," which are devices for removing a considerable part of the moisture content. Even after passing through the deckers, the solid content amounts to no more than three per cent. At this consistency it is delivered to the storage tanks.

The bolts destined for the sulphite process are conveyed from the barkers to the chippers. These are machines consisting essentially of revolving disks or cylinders (in some forms) bearing knives. The bolts are pressed against the disks, and the knives are so arranged that they cut the bolts into chips of fairly uniform size. The ideal chip is about five-eighths of an inch square, one-eighth of an inch in thickness, and has the grain cut at an angle of forty-five degrees. The chips pass through holes in the revolving disk of the chipper on to conveyors that bear them to crusher rollers. From the crushers they pass to the screens: first over flat screens with an oscillating motion and wide apertures; next to a cylindrical screen of finer

mesh, resembling the "grizzly" used in mining operations. After screening, the chips are ready for the digesters.

A digester is a huge vertical cylinder, consisting of a thick steel jacket lined with acid-proof brick. All metal-work exposed to the digestive fluid is of acid-resisting bronze. The digester is cone-shaped at the bottom and dome-shaped at the top. The chips and acid are poured into the digester through a manhole in the top, which is provided with a strong metal cap or cover. One meal or "cook" may consist of eight to ten tons of dry chips and twenty-five thousand gallons of sulphurous acid. When the metal lid has been bolted on, steam under pressure of about seventy to seventy-five pounds to the square inch is turned on. This forces the acid into the chips, and aids in cooking them. This cooking process really consists in dissolving out the encrusting material surrounding the cellulose fibres, thus setting them free and making them soft and pliable.

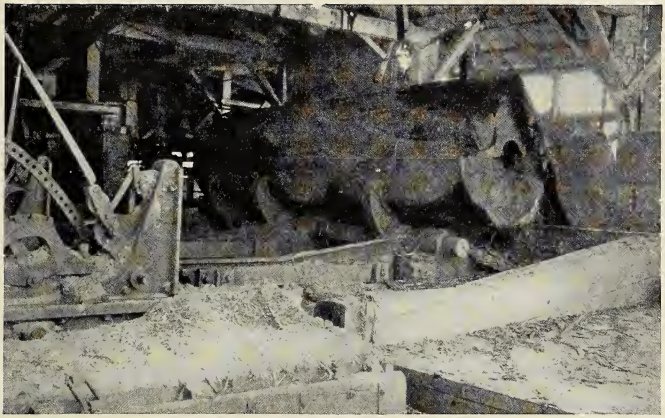
When the cooking process has been carried far enough, a valve is opened in the bottom of the digester, and under pressure of the steam, the contents are forced out of the digester into a cylindrical tank, commonly called a blow-pit. The sulphur fumes and steam are drawn aloft through vertical wooden stacks, and the liquor is drained off through the perforated bottom of the blow-pit. The pulp is flooded with water, and every trace of the sulphite liquor is washed out of it.

From the blow-pit the pulp is pumped into a storage tank. In highly diluted form it is then put through a series of screens, which take out in succession the knots, uncooked chips and finer slivers. These rejected portions of the pulp, after being put through a refiner and screened, are made into coarse wrapping-paper. The good pulp in a slightly thickened condition, about two and a half to three per cent pulp, goes into a storage tank, where it remains until it is required for the actual process of paper-making.

So far we have traced the making of the two kinds of pulp, mechanical and chemical, or groundwood and sulphite. In many mills the process, except for rolling, drying and folding the pulp for shipment, practically ends here. But, from this point on, the processes described are concerned with the

PHASES OF WORK IN A SHINGLE-MILL

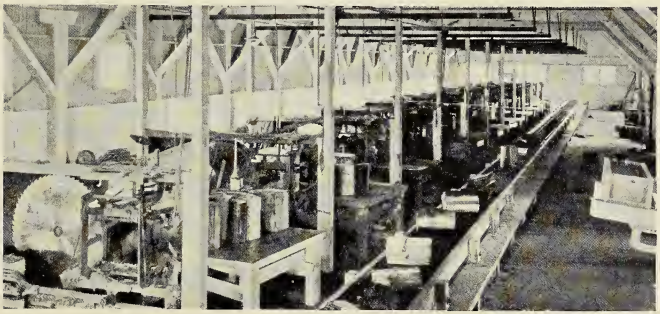
I



Department of the Interior

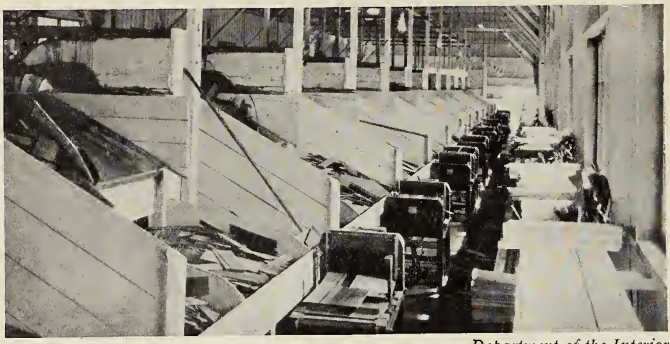
Logs must first be squared; then they will be cut into smaller blocks.

II



Department of the Interior

Notice the conveyor and the circular saws.



Department of the Interior

The shingles come down chutes to other conveyors.

conversion of the blended pulps into paper or news-print. The groundwood consists of short fibres, imperfectly separated and still retaining the encrusting materials: its purpose is to act as a filler and reduce the cost of the paper. The sulphite pulp has had most of the encrusting materials dissolved and washed away, the fibres are long and unbroken, well separated from each other: its chief purpose is to act as a binder.

We left the groundwood pulp and the sulphite pulp in separate storage tanks. Here they are in practically a liquid form, only about three per cent being pulp and the rest water. Quantities of groundwood and sulphite are now drawn off from the tanks in the proportion of seventy-five per cent of the mechanical to twenty-five per cent of the chemical pulp. Mixing takes place in large vats provided with agitators. If the paper is to be coloured, dye is now added to the mixture. For ordinary news-print no other ingredients are added: but if paper for special editions or similar purposes is required, resin size, alum and clay are added. The resin size is a kind of soap made from resin and soda ash: it helps to fill or coat the fibres, rendering the paper less absorbent. The purpose of the alum is to precipitate the resin; and the clay fills up the interstices of the paper, giving it a smoother surface.

After being mixed and blended in these vats, commonly known as beaters, the pulp is put through a machine called a jordan, which breaks up any bundles of fibres that may have escaped the beater or the screens: in other words, it performs the final work of filtration.

On leaving the jordan the stock is diluted until it contains only one-half of one per cent of pulp. Another screening then takes place, after which the long journey down the paper-making machine begins. The pulp is poured or sprayed from feed-boxes on to an endless travelling wire screen of very fine mesh, through which the water can pass, but not the pulp. Near the far end of this long screen are arranged a series of suction-boxes, that help in the work of extracting moisture from the pulp.

The wet sheet is passed to wide blankets, called felts, by means of a simple but ingenious contrivance known as the couch-roll, which revolves at the same speed as the wire screen. The felts carry the sheet of pulp under and over a series of rollers, pressing out the moisture and felting the fibres together. This end of the paper-machine is known as the wet end. From the felts the paper is "jumped" to a canvas sheet or belt, which conveys it over and under a series of cylinders heated by steam. In the journey the sheet of paper is gradually dried, until, when it reaches the calendar stack, it contains only about eight per cent moisture.

In the calendar stack, consisting of a vertical series of polished steel rollers, the paper is ironed out to a smooth finish. It is now wound into reels, as long as the width of the paper-making machine. Being too wide for commercial uses, it is unwound, and, while being re-wound on smaller reels, is cut to whatever width is required. These final reels are wrapped, labelled, weighed and wheeled to the shipping department.

Canadian news-print exports for the year 1926 reached a total of nearly one and three-quarter million tons, valued at over one hundred and fourteen million dollars. About ninety-four per cent of the exported news-print went to the United States, the remainder being shipped to South America, Australia, New Zealand and South Africa. The total exports

of pulp for the same year were over one million tons. Besides the ordinary pulp, Canada produces for export an increasing quantity of bleached sulphite, used in the manufacture of rayon, or artificial silk.

51. THE MILLING AND SHIPPING OF LUMBER

In Western Canada mills must be equipped to handle logs of great size. After the booms have been towed to the booming-ground, contiguous to the mill, they are carefully scaled, broken open and fed, log by log, to the saws. The floor of the mill on which the logs are converted into lumber is at a considerable elevation above sea-level. Each log is guided to the foot of a slip or trough, up which it travels into the mill. On the bottom of this trough is an endless chain, carrying "chairs" with sharp-pointed seats, upon which the log rests while it is drawn up the slope. When it reaches the top of the slope, it rests for a moment on a platform, known as the log-stop and loader.

This log has been roughly handled before: bucked from its parent tree, choked and hauled through space by an overhead cable, dropped at the yarding-point, loaded on a logging train, dumped into the sea, and herded into the confines of a boom. But the handling it has hitherto received may be described as gentle in comparison with what is to follow. From the floor where it is resting rise arms of steel that lift it bodily and hurl it forward towards the carriage which is to bear it to the saw. A mighty cant-hook, called a Simmonson, also rises from the floor, grasps and holds the log, while heaving shoulders, worked by the same unseen power, rise and force it into its place upon the carriage. Two men, riding on this carriage, operate "gun-shot," adjustable hooks, which clamp the log to its place. The carriage runs smoothly along a wide track, and the log is fed to a band-saw, which rips off a wide slab. Another cut or two are taken off this side of the log, when it

is again seized by the Simmonson log-turner and placed with its flat side on the carriage. After squaring on two sides, the log is slid over by lift-skids to another carriage and crew, who cut it into whatever dimensions are required.

The long slabs, as they fall from the log, are borne by a roller-conveyor past a man who draws a circular saw across, cutting them into more convenient lengths. They drop to a lower chain-conveyor that carries them, along with stuff from the edger, through a battery of saws of the circular type, spaced four feet apart. Reduced to four-foot lengths, or less, the slabs and edgings, accompanied by short ends and trimmings, brought by other conveyors, descend by a trough and chain-conveyor to the lower floor of the mill, where they are sorted as they go by: the better pieces are sent to the bolter, and from there to the lath machine; the pieces of inside fir are thrown into one conveyor, the slabs and edgings into another. On the way the pieces are cut into foot lengths automatically by sets of parallel circular saws. The inside fir is carried direct to a bunker, from which it is loaded into carts or trucks and sold as firewood: a sorter separates the slabs from the edgings, each going to a separate bunker. The other refuse, consisting largely of bark, goes to the burner.

The second and following cuts from the log are passed across to a parallel roller-conveyor by means of short chain-conveyors operating at right angles to the rollers. These chain-conveyors are set below the level of the rollers, but are lifted above that level at the will of the man who operates the slab trimmer. The long cuts proceed along the second roller-conveyor to the edger. The edgings are thrown down to the chain-conveyor, and the "flats" fall or are fed to a broad chain-conveyor leading to the automatic trimmer. This consists of a battery of circular saws operated and controlled by the trimmer-man, who, perched in his watch-tower, keeps an observant eye on the pieces of timber that are slowly making their way up the conveyor. In front of him is a list of the orders that are being filled by the mill, and he must cut the timber to the proper lengths. If a board contains a bad knot or other imperfection in the centre, he lets down two saws and cuts out the

objectionable part. The value of the mill-run may be greatly increased by employing an efficient trimmer-man.

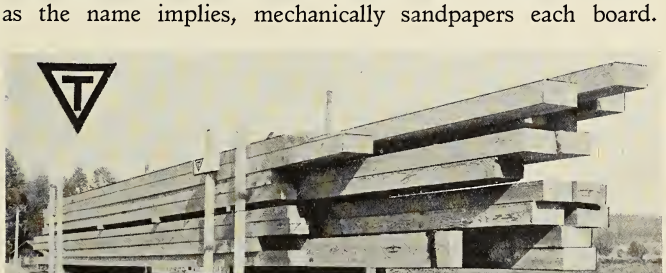
From the automatic trimmer the timber proceeds along a roller-conveyor to the sorting-table. This is a long wide platform, along which a series of chain-conveyors move in a direction at right angles to the main part of the mill. A lower platform runs on each side of the sorting-table. Upon these stand a number of men, whose duty it is to classify the lumber that is ready to go to the yard or dry-kiln, to remove the pieces of a certain size and quality into their respective piles, and to place on roller-conveyors material that has to be re-sawn. When the re-sawing has been accomplished, the lumber is conveyed back to the sorting-table, where it is again inspected and, at the proper point, removed from the table and placed on the pile to which it belongs. It must be remembered that the lumber travels along this table by means of the continuous chains that traverse its surface. The men on the side platforms maintain their positions, examine each piece of lumber as it comes along, and either let it pass by or deal with it in one of the ways already indicated.

Cranes, derricks or trucks are employed to carry away the piles of lumber that form on either side of the sorting-table. Most of this must go to the dry-kiln before it is taken to the planer. Large structural timber, however, is either shipped in its rough state or sent direct to the planer from the saws. Steam heat is usually employed in the kilns. The air in the kilns must be kept at a certain humidity, or the lumber will check at the ends. Before entering the kilns the lumber is neatly and methodically piled on special trucks. The layers of lumber are separated by narrow strips, and three or four inches of space are left between the boards in each layer, so that the heat can reach every surface.

The lumber is all carefully inspected and graded before it goes into the kiln. When a rush order has to be filled, the lumber is put into the "fast" kiln. Heat is maintained at about two hundred and forty degrees Fahrenheit. One-inch material, from which are to be manufactured flooring, siding or V-joint, remains in the fast kiln from thirty-five to forty-eight hours;

the heavier sizes remain from fifty to sixty hours. Where time permits, the lumber is put into the "progressive" dry-kiln. In this kiln trucks of lumber may be put in or taken out at any time. When steam has been served to a truck a certain length of time it is shut off automatically. As a rule the lumber remains in the progressive kiln about three days.

From the kiln the lumber goes to the planers, which give to it the final form and finish required. The last machine the double-dressed lumber passes through is the "sander," which, as the name implies, mechanically sandpapers each board.



Department of the Interior

SHIPPING BRIDGE CHORDS

Tied into convenient bundles, and stamped with the name of the mill, the finished lumber is ready for shipment. It is graded as number one, number two or number three, according to its freedom from knots, checks and other imperfections. The best flooring is made of the edge-grained lumber. Flat-grained lumber is preferred for door- and window-casings, panelling, or for other purposes where stain or varnish is to be used as a finish.

In a separate part of the mill equipment is repaired and saws are sharpened. The heavy band-saws employed in cutting the logs must be sharpened every two or three hours. The filing is done by machinery, under the direction of a man specially skilled in this work. When a saw is removed another

is fitted into its place, and the work of cutting goes on with little interruption.

In many mills the sawdust is used as fuel in the furnaces which heat the boilers. It is fed to them automatically by special conveyors. If more sawdust is produced than can be used for this purpose, the surplus is blown to the burner. In modern mills the burners are provided with a combustion chamber, so as to render them practically smokeless. The outer jacket of the burner is formed of riveted steel plates, and inside is a lining of firebrick. The floor is formed of two feet of firebrick resting on a concrete foundation. Although little goes into the burner but sawdust, bark and small trimmings, the time will eventually come when even these residues of the milling process will be utilised in the manufacture of some by-product of service to man. The mill here described, being close to a large city, can find a ready market for its slabs, edgings and larger trimmings: but in the case of mills not so situated, all this material must go to the burner.

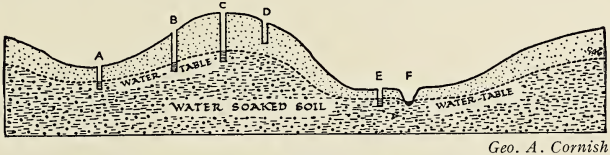
There is much better conservation of timber in the Eastern sawmills than in those of the West. This is owing to several causes: (1) greater number of manufacturing plants in the East capable of utilising small pieces of lumber; (2) urgent need of conservation in the East, owing to dwindling forest resources; (3) use of much heavier saws in Western mills; (4) lack of local markets in the West to consume culled or undersized lumber.

Canadian lumber finds its best market in the United States, but Great Britain is taking a steadily increasing quantity of our output. Our lumber trade with the Orient has become an important feature of the Western market. There is hardly a country in the world that does not draw on our timber resources in one form or another: Japan, China, Australia, South Africa, Egypt, various countries in South America, France, Belgium, Holland and Germany—all take toll of our forest products.

52. OUR WEALTH OF WATERS

WATER is the source of all life on the earth as well as in the sea. Every cell in our body is bathed in it. It is of more importance to man than the soil; for without water the richest soil would be a barren waste. Air and water contain the elements essential to plant and animal life. By the agency of water deserts have been changed into smiling, fruitful fields; and by denuding a fruitful land of its forests, and thereby reducing its hidden stores of water, it has been converted into a desert.

The waters under the earth are just as important to man as those on its surface: indeed, they are more important; for



Geo. A. Cornish

SECTION THROUGH EARTH SHOWING THE RELATION OF WELLS TO THE WATER-TABLE

The dotted line is the water-table. A, B, C, D, and E are wells. Which is dry? F is a stream.

not only is plant life, including the forest, largely dependent upon these subterranean reserves, but the water-supply of cities, towns, villages and farms, directly or indirectly, comes from this source.

This underground water, or ground-water, as it is called, is held in the soil, sand, gravel and porous rocks which form the upper strata of the earth's crust. Though lying at different depths in irregular undulations, its upper surface is known as the water-table. It has been estimated that the ground-water represents about seven years' rainfall, and is sufficient in quantity to cover the land surface of the earth to the depth of seventeen feet.

It is of vital importance that we conserve this underground supply, and protect it from contamination. The lowering of the water-table may mean the drying up of wells, the failure

of crops, and the destruction of forests, along with the wild life they shelter or support. This depression of the water-table may result from the following causes:

1. Waste of the water drawn from wells, piped to cities or used in irrigation.
2. Removal of forest growth and failure to renew it.
3. Draining of swamps, construction of sewers.
4. Unscientific methods of farming.
5. Development of water-powers for industrial purposes.

When people leave their taps running needlessly, they probably do not think of the drain they are making on the water-supply of their district. The lowering of pressure in water-mains, due to this cause alone, may result in destruction of life and property by fire; it may close down industrial plants that depend, for their power, on a certain head of water in lake or river; and it may even curtail navigation.

Much of the water in irrigation ditches is wasted through seepage, evaporation and the adoption of a continuous-flow system. Too many farmers seem to think that irrigation can take the place of cultivation. Less water will be required on land that is kept in a proper condition of tilth. Use of the hoe will save use of the hose in our gardens.

Forests are the most important factor in problems relating to water conservation. To remove them from fertile plains is perhaps a necessity: to remove them from the hills is a fatal error; but to remove them from the mountains is a crime. Wherever they are, forests conserve the water-supply, both ground-water and surface-water, by:

1. Preventing rapid evaporation by sun and wind.
2. Supplying a spongy bed for the absorption of rainfall.
3. Delaying the melting of snows.
4. Maintaining a constant run-off into lakes and rivers.

Canada's wealth of waters, though vast, is directly dependent for its maintenance on a sound system of forest protection. Great credit is due to the Provincial and Federal Governments for the efforts they are making to control by wise legislation the exploitation of our forest resources, for their

foresight in setting aside extensive areas as forest reserves, and for their attempt to reduce the fire-hazard in our timbered areas, by educating the youth of our land to protect their heritage, and by obtaining the whole-hearted co-operation of the citizens of Canada.

Canada is exceptionally blessed with a great wealth of inland waters. Her total water area is estimated to be 125,755 square miles. In order to calculate the hydro-electric power which can be developed from this vast expanse of waters, reliable data are required concerning the rivers and lakes that compose it. We must know, for instance:

1. The depth of water and extent of watershed in connection with each lake.
2. The amount of water discharged per second by each stream at times of minimum flow.
3. The effective fall in feet at points where hydro-electric plants might be installed.
4. The periods during which these lakes and streams are frozen over.

Some lakes, though of large area, are shallow, and the amount of water available for power purposes is consequently small, as compared with that of lakes having less area but greater depth. In the far North many of our shallow lakes and rivers are frozen solid for several months in the year. It must be remembered, too, that the greater the area of a lake, the greater is its loss through evaporation.

The St. Lawrence River, including the Great Lakes and tributary streams, is the largest and most important fresh-water system in the world. It is of inestimable value to Canada in many ways, but particularly in the following:

1. It affords cheap water transportation for the grain of the Prairie Provinces.
2. It provides Ontario and Quebec with almost unlimited water-power.
3. It has extensive fisheries.
4. Its broad expanse of water has an ameliorating effect on climate.

Ontario and Quebec are fortunate in possessing such vast and well-distributed sources of hydro-electric power, which more than offset the lack of coal for industrial purposes. They are also fortunate in possessing such an abundance of raw material in wood and metal as will warrant the development of their water-power to its fullest extent. The mines of the Canadian Shield can be sure of obtaining adequate and economical energy to drive their air-compressors and turn the wheels in mills and concentrators. Pulp- and paper-mills can be built close to the forests that feed them; and the older centres of southern Ontario and Quebec, where manufacturing industries are of first importance, have abundant water-power to meet all demands.

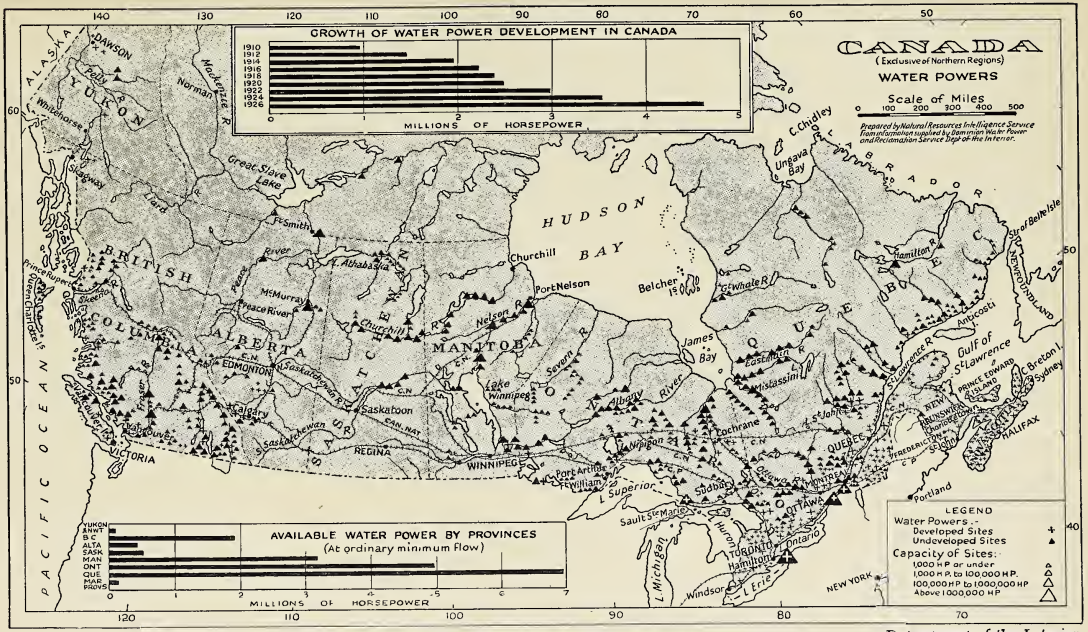
The other provinces of Canada, with the exception of Prince Edward Island and possibly Saskatchewan, have undeveloped water-powers, which will be adequate to their future industrial needs.

As an attraction for tourists and as a means of recreation for our own people, the lakes and rivers of Canada have a high value that cannot be reckoned in horse-power or in dollars and cents. In the far North, thousands of lakes that seem to have no present commercial importance are, nevertheless, performing a very useful purpose in attracting the feathered tourists of the air. Without these sanctuaries and nesting-places, many species of birds would become extinct, and in the fall no flights of wild-fowl would gladden the eye of the hunter.

53. HYDRO-ELECTRIC POWER

The recent rapid development of the water-powers of Canada has played an important part in her phenomenal industrial expansion. Out of the 41,700,000 horse-power potentially available in our Dominion, about 10·5 per cent has been harnessed and put to the service of man.

A great industry in itself, the generation of hydro-electric power means the fostering of a band of other industries, directly


GROWTH OF WATER POWER DEVELOPMENT IN CANADA
1910
1912
1914
1916
1918
1920
1922
1924
1926
0 1 2 3 4 5
MILLIONS OF HORSEPOWER
CANADA
(Exclusive of Northern Regions)
WATER POWERS
Scale of Miles
0 100 200 300 400 500
Prepared by Natural Resources Intelligence Service from information supplied by Dominion Water Power and Reclamation Service Dept. of the Interior.
AVAILABLE WATER POWER BY PROVINCES
(At ordinary minimum Flow)
YUKON
N.W.T.
B.C.
ALTA.
SASK.
MAN.
ONT.
QUE.
MAR. PROVS.
0 1 2 3 4 5 6 7
MILLIONS OF HORSEPOWER
LEGEND
Water Powers:-
Developed Sites
Undeveloped Sites
Capacity of Sites:
1,000 H.P. or under
1,000 H.P. to 100,000 H.P.
100,000 H.P. to 1,000,000 H.P.
Above 1,000,000 H.P.
HUDSON BAY
PACIFIC OCEAN
ALASKA
YUKON
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
LABRADOR
Dawson
Whitehorse
Skagway
Yukon R.
Mackenzie R.
Great Slave Lake
Fort Smith
Peace River
McMurray
Athabaska R.
Churchill R.
Nelson R.
Port Nelson
Churchill
Belcher Is.
Whale R.
James Bay
Eastmain R.
Rupert R.
Abitibi R.
Lake Winnipeg
Severn R.
Albany R.
Moose R.
Cochrane
St. John R.
Lake St. John
Saguenay R.
St. Lawrence R.
Gulf of St. Lawrence
Anticosti
Hamilton R.
Strait of Belle Isle
Cape Breton I.
Sydney
Prince Edward Island
Fredericton
St. John
Halifax
Edmonton
Saskatoon
Calgary
Regina
Victoria
Vancouver
Prince Rupert
Winnipeg
Port Arthur
Fort William
L. Superior
Sault Ste. Marie
Sudbury
Ottawa
Montreal
Toronto
Hamilton
Ontario
L. Michigan
Windsor
L. Erie
Portland
New York
C. Chidley
Ungava Bay
Nain
Hopedale
Okak
Hebron
Cape Harrison
Cape Charles
Cape Ray
Cape Race
St. John's
Grand Falls
Corner Brook
Port aux Basques
Bay of Fundy
Gulf of St. Lawrence
Lake Ontario
Lake Erie
Lake Michigan
Lake Superior
Lake Huron
Lake Ontario
Lake Erie
Lake Winnipeg
Lake St. John
Lake Nipissing
Lake Timiskaming
Lake Abitibi
Lake Nipigon
Lake Winnipeg
Lake Manitoba
Lake Athabaska
Great Slave Lake
Great Bear Lake

dependent upon it. Pulp- and paper-mills, electro-chemical, electro-metallurgical and mining plants, street-railways, the lighting systems of cities, towns, villages, and even rural municipalities, are all run by energy derived from this source.

By means of a switch you may either turn on your reading-lamp or set the machinery of a factory in motion: there is a store of energy ready, without a moment's notice, to make your morning toast or drive a street-car. If you live on a farm, much of the drudgery and inconvenience connected with "doing the chores" has been removed by the introduction of electric appliances. By the aid of electricity you can cut the wood, milk the cows, and fill the silo; in the dairy it drives the cream-separator and works the churn; in the house it operates the vacuum-cleaner and washes the clothes. In a thousand similar ways this invisible giant is waiting to serve you. He is more potent than the genii summoned by Aladdin's lamp; for his creations are realities and not phantoms of the imagination.

How is this mighty force generated and controlled? To explain it fully would take many volumes; to understand it thoroughly would require a course in a technical college; but to outline the general plan followed in converting water-power into electric energy is well within the scope of a short article, and that is all that we shall attempt to accomplish at the present time.

The installation of a hydro-electric system may be undertaken by either a private company or a public corporation. In the former case, the object may be to operate a single plant, such as a pulp-mill or an electro-chemical works; or it may be intended to sell the current generated to municipalities for the operation of public utilities, such as street-railways and electric-light systems. Whoever may acquire the water rights, and for whatsoever purpose the hydro-electric energy may be intended, the method of procedure is the same.

In the first place, the company or corporation must legally acquire the right to develop hydro-electric power from the waters of a certain lake or stream, or from both. But before obtaining this right they must be able to state clearly for what purpose

the power will be used, whether it will encroach upon any existing water rights, such as those for placer-mining or irrigation; and whether the health or safety of the community will be endangered by the installation or operation of such a plant.

Even before these matters are definitely settled, engineers will be employed to make a careful survey of the district and the streams or other waters it is proposed to utilise. By means of current meters or floats they will determine the velocity of streams, their cross-sectional area and volume of discharge at all times of the year, but especially at the time of minimum flow. Official Government records of annual precipitation will be obtained and carefully studied, in order to determine what amount of water they can depend upon in the dry season, or must take care of in times of flood. The watershed area of lakes or valleys in the vicinity will be measured, as well as the depth and area of the lakes themselves. The slopes of mountains will be examined to determine whether the melting of snows will be gradual, giving a constant run-off, which will be the case if they are forested; or whether snowfall and rainfall will be rapidly discharged into lakes and streams, which will be the case if the mountain slopes are bare.

With all these data in their possession, together with much other information, including the total horse-power which the water-site is capable of developing, and having obtained from the Government a lease or other charter to the water rights involved, the company or corporation is in a position to begin construction work. This may involve much preliminary work, such as the building of roads and bridges and the clearing of land.

The power-plant itself will probably consist of one or more power-houses; a dam with spillways to control the head of water; penstocks or pipes to convey the water to the turbines; the wheel-pits to receive these turbines; the generators that are to convert water-power into electric energy; the transformers that are to step up or increase the voltage; and the transmission lines that are to carry the current to the industrial plant or public utility station, where it is to be used in performing some useful work.

Winnipeg's hydro-electric system is a good example of a municipally-owned power-plant. The power site is located at a point on the Winnipeg River, and is connected with the city by a duplicate transmission line, seventy-seven miles long, borne on steel towers. Though provision was made for the installation of sixteen wheel-pits, the power-house as originally constructed included only eight. At that time turbines and generators capable of delivering 20,000 horse-power were put in operation. As the demand for electric power and light increased, it was found necessary to extend the power-house so as to include the remaining wheel-pits. When the additional turbines and machines were installed, the capacity of the plant was brought up to 100,000 horse-power.

The preliminary work in connection with the construction of this system included the building of a bridge 1100 ft. long, twenty miles of railway, and a dam across the Winnipeg River. This plant is utilising all the power available at Pointe du Bois; but another site at Slave Falls will supplement it with an additional 70,000 horse-power.

54. THE WATER-SUPPLY OF CITIES

THE cub engineer, who was just out of college and thought that, because he had wrestled successfully with the differential calculus, he was capable of tackling anything in the engineering line, was somewhat disgusted when the chief assigned him the duties of rodman to a sub. The rod was of the telescopic type: with a bag of wooden hubs and an axe for driving them, it constituted his equipment for the field. The sub-engineer carried a Y-level, a notebook, and a map of the city and suburbs.

They started work at the market-square, and took levels on four streets, running to the four cardinal points of the compass. The streets crossed the city boundaries and merged into dusty country roads; but still the sub kept going, fixing permanent bench-marks at all street or road intersections. The cub won-

dered what it was all about; but he had to bide his time, for his superiors were not inclined to be communicative. His immediate duty was to drive a hub, set his rod on it, and watch for the next signal from the engineer, who very carefully levelled his instrument, took a reading, checked it, and made an entry in his notebook.

After the main lines of levels had been run, the cross-roads and side-streets were treated in the same way. Each afternoon, on returning to the office, the levels taken during the day were plotted on long sheets of profile paper by an office assistant. The chief never seemed to bother his head about these operations, and the cub wondered how such a highly paid official earned his salary. But one day the chief asked him to bring an axe and accompany him on a trip up the river. Arriving at a point where the river formed a loop, almost surrounding a wooded flat of many acres, the chief pointed out places to be marked with stakes. The cub cut and drove the stakes, wondering more than ever what it was all about. Before leaving the spot, the chief enlightened him.

"At each of these stakes I shall have a drive-well sunk. At the river I want you to install a water-gauge. When the wells are all driven you will make daily readings of the water-level at the river and in the wells. Reduce your readings to the city datum by tying on to the nearest bench-mark."

Delighted with his first assignment, the cub took every pains to keep neat and accurate records of the daily fluctuations in water-level of river and wells. It became apparent that all this accumulation of data, preparation of plans and profiles, and drawing up of specifications, had to do with the installation of a waterworks for the city. By-laws were voted on and passed, authorising the city to raise money by the sale of debentures to defray the cost of the undertaking.

Next spring construction work began. The source of supply was the water contained in the gravel flat, in which the test wells had been driven. The city at that time had 12,000 population, and the cub wondered whether the chief might have made a mistake in estimating that an adequate supply of water could be obtained from such a source. But he had come to have a great

respect for the chief; so he was content to perform the simple tasks assigned him and await results.

A well fifteen feet in diameter, lined with concrete, was built to receive the water from two rows of perforated vitrified pipe laid in the bed of gravel near the river. These were covered with screened gravel, through which the water must pass to reach the perforations. From the well iron water-mains led to the city, where they branched into sub-mains that served every street. These mains and sub-mains were laid at an average depth of eight feet, which took them well below frost-level. At various points valves were placed, so that the water could be shut off from a sub-main without disturbing the whole system.

The pipe joints were first caulked with oakum, so that their inside diameters fitted perfectly; then a collar, open at the top, was fitted around the pipe close to the joint, and molten lead poured in. The lead found its way into the space between the pipe and the bell into which it was fitted. After removing the collar, the pipe-layers drove the lead well home with their caulking-irons.

At street intersections hydrants were placed, and at each city lot a service pipe was laid to the street line, to be carried, later on, into store, shop, or dwelling. The latter work would be done by the plumber, under inspection of the city engineer's department.

The power that drew the water from the well, and forced it through the system of mains, sub-mains and service pipes, was supplied by two powerful compound engines, installed in an engine-house close to the well. The system as a whole proved a success. Though contamination existed in the river-water, none found its way through the natural filter-bed formed by the intervening sand and gravel.

One of the most important engineering works undertaken in Canada was the construction of the present Winnipeg water system. The source of supply is Shoal Lake, which can furnish sufficient water for a city of 850,000 inhabitants. As the Greater Winnipeg Water District has a population of 220,000, it will not be necessary to draw on the contingent source of supply,

the inexhaustible waters of the Lake of the Woods, for many years to come.

The water is brought by the gravity system a total distance of 96·5 miles. From Shoal Lake, which has an area of 107 square miles, the water is conveyed 77·5 miles in a concrete aqueduct, having a minimum cross-section of 6 ft. $4\frac{3}{4}$ in. by 5 ft. $4\frac{3}{4}$ in., and a capacity of 85,000,000 imperial gallons per day, to a reservoir, from which it passes through a reinforced concrete pressure pipe, 5 ft. 6 in. in diameter, to the Red River. Under this river the water is carried in a five-foot cast-iron pipe laid in a tunnel. From the Red River to the reservoir at Winnipeg, the water is conveyed by a four-foot reinforced concrete pressure pipe, capable of discharging 30,000,000 gallons per day.

55. THE PROBLEM OF MODERN SANITATION

Modern sanitation began with the installation of complete systems of waterworks in cities. Without an adequate water-supply, modern systems of sanitation are impossible. Sewers and waterworks are inseparably connected: the one implies the other. In former times water was drawn from wells, and the disposal of sewage was left to Nature. We may look with horror on such unscientific and primitive conditions; we may wonder why plague and pestilence did not sweep the human race from the face of the earth: but the fact remains that China, one of the most populous countries, in the matter of sanitation follows the custom of ancient days.

No one disputes the fact that scientific systems of sanitation have done much towards prolonging the span of human life and in reducing infant mortality, especially in large cities. But in order to attain this result we are paying a price that may ultimately bankrupt the world. Man has done more to disturb the balance of Nature than any other factor in the universe. He has set himself the task of mastering and controlling the forces of Nature; but he seems to forget that he cannot alter

her laws. All life came from the sea, and to the sea all life will ultimately return. If the balance of Nature were undisturbed, this ultimate destiny would be too remote to cause us any concern. But man has unwittingly allied himself with the forces of destruction that are remorselessly bearing the treasures of earth into the fathomless depths of the sea. Into every modern city are annually borne thousands of tons of organic substances—vegetables, fruit, grain and animal products—that Nature would use over and over again in the replenishing of plant and animal life. This material is her capital, her raw material, from which she manufactures her multitudinous forms. When it is gone, life will cease to exist on the earth: yet we throw this invaluable substance into the rivers and cast it into the sea, where it is for ever lost to the service of man. If we were to express the value of this wasted wealth in money, it would annually amount to billions of dollars: all the gold that is mined would not pay for it.

Man is directing his attention to conservation of natural resources, such as minerals, forests, game and fish, because the time of their depletion is within range of his vision: but the preservation of the basic natural resource of life is neglected, because it concerns not ourselves or our immediate posterity, but future generations. Man is so selfish in this respect that he will not even pay his petty debt to Nature by returning his own meagre body to the soil: he must preserve it in imperishable form, planting it deep, where it can never mingle its dust with the nourishing earth.

You may wonder what this has to do with modern sanitation; but a little thought will convince you that modern systems of sanitation are wholly responsible for the suicidal waste we have described. If man is to live in great cities he must provide for the health of their inhabitants; but in so doing he has no right to sacrifice the lives of countless generations yet unborn. And that is precisely what his wasteful acts will lead to.

It may be asked: Is there a practical, rational solution of the problem? Can a method of sanitation be devised that will eliminate this waste? The answer should be emphatically in the affirmative: but men in power and authority, who have the

destinies of present and future generations in their hands, will tell you that the cost of installing and operating such a system of sanitation would be prohibitive. So it is, in the last analysis, a question of cost. We get immunity from disease without having to pay the full price.

Systems of sewage disposal have been devised, and even put into operation on a large scale, that provided for the return to the soil of every pound of substance that comes from it, except the small amount embalmed in the bodies of the dead. Sewage farms, which were operated as an integral part of some sewerage systems, could not be made to pay: therefore, in most cases, the schemes of sanitation involving their use were abandoned. Again, you see, it was a question of cost.

There are systems of sanitation in use in some cities of continental Europe, as well as in Great Britain, that provide for a wider distribution of the sewage than is possible on the irrigated sewage farm, and the fertility of the soil over large areas is thus maintained or even increased. These cities may receive no direct money dividends from their sewerage systems; but even if the balance is on the wrong side of the ledger, the people of these cities have the satisfaction of knowing that they are not parasites on posterity.

There are two recognised systems of sewerage: the combined and the separate. In the former, the storm-water is conveyed in the same pipes that carry the sewage; in the latter, separate systems of pipes are employed. Where utilisation of the sewage on sewage farms or in other ways is contemplated, the separate system is preferable; for the large water content of the substances to be disposed of presents the most serious difficulty to the engineer.

The League of Nations is beginning to function as a body of international control in other matters than the petty rivalries of states. There is no problem more vital, more insistently urgent of solution, than that of an international system of sanitation; and it is to be hoped that the collective wisdom and strength of that august body, when directed to this subject, will provide for the conservation of soil fertility.

56. THE BUILDING OF A HOME

James Rogers was sixty years old when his family planned that he should retire from his prosperous farm of three sections in Manitoba, and build a home in the city, where his wife and children could share the advantages of urban life, and where he could rest from the labour and anxiety of farming. The home section was sold to his two eldest sons at $20 an acre, including stock and machinery, on an easy-payment plan; another section was sold to a neighbour at $30 an acre, one-third cash and the balance spread over six years; while the third section was rented for five years at $1000 a year. Mr. and Mrs. Rogers, the two daughters, and Jack, the youngest, a boy of fifteen, made a trip to the Pacific Coast, in order to find the place that they would desire for a home. When they reached Victoria, they all agreed that their search was ended, for the mild climate, the ocean, and the arboreal setting of the city, all invited them to stay.

On a charming rise, fringed with oak-trees and facing the ocean, they bought one and a quarter acres of land, valued at $3000 an acre, with a street frontage of 132 feet. The purchase was made on the first day of April, through a real estate agent, who induced the owner to take 10 per cent from the list price, as Mr. Rogers was able to pay cash. The agent kept 5 per cent of the selling price for his commission, the deed was made out, signed, witnessed and registered, the taxes of $160 for the year were adjusted, the owner allowing the buyer credit for $40, and the transaction was completed.

The family rented a furnished house within walking distance of the land for $60 a month. Jack entered the high school at once, for his mother hoped that he would be a doctor, and the rest started the fascinating work of planning and building a home. First they consulted a contractor, whose business was to build houses, and he showed them plans of the different floors, elevations, and sketches of how the various types would appear when finished; but when Mrs. Rogers could find no

pantry in the plans; when Mr. Rogers, who is a very large man, paced off the size of the kitchen and found that there would not be room to sit between the table and the stove; when he found that all his ideas were old-fashioned and were not included in the latest plans of city homes, and when he saw the price that even a modest house would cost, they went home in despair.

After an evening's meditation Mr. Rogers delivered a verdict: "We have lived in a house for sixty years more or less, and if we do not know yet what kind of a house we want, and how it should be planned, when we have to live in it, let us go back to the farm, where I planned and built the best set of buildings for twenty miles round. Let us agree on what we want, then I will draw the plans myself and hire workmen to build the house." "Now, James," said his wife, "I know too much about the kind of home that you would build. Do you remember our first house on the prairie that you designed, in which we had to move the organ every time we opened the trapdoor to go down cellar, and how we had to step upon the stove to climb upstairs, and could not go to bed until the fire went out? We might do this: sketch in a rough way what we want, and then get an architect to draw proper plans."

So it was agreed; but when Mr. Rogers sought an architect with his plans he was plainly told that there was no room to get upstairs or into the basement, that the windows did not balance, that the fire-place would not draw, and that four of the doors would swing the wrong way; but for $250 the architect would draw the plans for a ten-thousand-dollar modern home, and superintend its building. The farmer went home, but not in despair, for on the way he purchased a heavy brass ruler, several large sheets of stout drawing-paper, and a bottle of Indian ink. The next three days were trying ones in the Rogers family, but finally, after many mistakes, the floor plans were drawn to scale.

A basement plan, end and side elevations, were added; and Mr. Rogers went to the city hall to have his plans approved, and to obtain a building permit. There he was told that the plans must be blue-printed; so he took them to a shop doing

that special work, and saw his drawings fastened to white sheets, which were dipped in a chemical bath, put through a roller, and came out blue, with the black drawings appearing as white lines on their surfaces. As they only cost 25 cents a sheet, he had six copies of each made, one for the city to file, one to mail to the boys, and the others to keep for the carpenters. Back at the building-inspector's office, his plans were approved, and he was granted a building permit to erect a house costing $8000. The price of the permit was one-tenth of 1 per cent of the estimated cost of the house. Mr. Rogers's new house was assigned a street number by the inspector, and listed for trade reference; so that for the next month he received a heavy mail from the building trades, offering their services for such work as wiring, heating, plastering, painting, etc. As he was a stranger in the city, this advertising was kept for future reference, and from it he was able later to get quotations on work.

At the very outset, Mr. Rogers planned to use only Canadian material in the construction of his new home; so he kept a record of the places manufacturing the articles that he used. He argued rightly that, if our country is to become prosperous through manufacturing, we must patronise our own industries. The next problem was to secure a very experienced carpenter, who would be able to superintend the building of the house. A capable man was found who had learned his trade as an apprentice in England, and who undertook to see that the construction work and finishing were thoroughly and properly done. This man was paid $8 a day for a forty-four-hour week, and an assistant received the union wage of $7 a day. Mr. Rogers planned to do much of the rough work himself, such as handling the lumber, preparing the basement and straight nailing work, while buying and receiving the material would require much time.

He bargained with a lumber firm to supply No. 1 Douglas fir for rough lumber, delivered at prices ranging from twenty-two to twenty-five dollars per thousand board feet, with the sales tax of five per cent extra. This lumber was milled at Alberni, and the amount used exceeded thirty thousand feet. The next purchase was a few tools, such as a hammer made in Hamilton,

and a hand-saw, pick and shovel from Galt. A load of lumber was delivered, and the city was asked to pipe water to the lot, so that the cement could be mixed. In connecting up the water, the city installed a water-meter, so that one's rate depends upon the amount used, and Mr. Rogers was pleased to note that it was made in Toronto.

Next morning the carpenters arrived with their tools, and work began. The first thing done was to stake out the exact location for the house and join the corner stakes with cord, to serve as a guide in digging for the cement foundation. In Eastern Canada a cellar would be necessary, but on the Pacific Coast the cellar is above ground, in the form of a basement, because of the mild and wet winters. While the carpenters built a tool-house on the lot, Mr. Rogers dug the trench two feet deep for the cement foundation. The carpenters then built board supports eight inches apart for containing the cement, and braced these walls very carefully, so that the foundation would be straight. While they were working, Mr. Rogers suddenly remembered that he had failed to notice where the nails were made, but, searching about, he found the head of the hundred-pound nail-keg, and on it was stamped "Hamilton, Ont."

The carpenters found work elsewhere during the week necessary for the pouring and hardening of the cement. To compound the mixture forty sacks of cement, made at Bamberton, near Victoria, each weighing a hundred pounds, at $1·10 a sack, were used, with fifteen cubic yards of coarse and fine gravel, the mixture being called "navvy Jack," and costing $2·80 a yard. As soon as the gravel company had delivered the material, a man appeared with a little gasoline cement-mixer, and offered to take the contract for putting in the cement at $34. Mr. Rogers first examined the contrivance and, after scraping off several layers of cement with his jack-knife, found that it was made in Hamilton, so he awarded the contract.

So busy was the retired farmer that he had little time to reflect on whether he enjoyed the city better than the country. In the evening at home, when the neighbours strolled by, they never spoke to him or stopped to talk, while in the country

the custom is to converse at length with the few people that one meets. He used to wonder what his neighbours' names and occupations were, and what their ideas were on some of the things that were strange to him in the city. One evening, to sharpen his pocket-knife, he walked many blocks trying to discover a grindstone, and at last decided there was none in the city; so next day he ordered one, that was made in London, Ontario, though the stone had been brought from New Brunswick. He was never lonesome after that; for every evening a neighbour would come to sharpen a pocket-knife, bread-knife, or axe, and he found city men quite human after all.

The sills were laid on the cement, the basement wall studded in, the stringers were laid on top and covered by the first floor, and the frame for the walls rose in sections. Level and plumb-line were in constant use, and tie-boards kept the skeleton frame in place. The window openings were framed, heavily reinforced for the big plate-glass windows of the sunroom and living-room, that gave a view over the sea. The roof was covered with four x shingles, the best, of red cedar, from the Alberni mills, and required 24,000 shingles, costing $3·74 a thousand, which covered 100 square feet. The shingles were laid by an expert shingler for $1·50 a thousand. He carried the nails in his mouth, and picked them out with uncanny swiftness, driving them into the shingles with one tap of his hatchet.

As the roof was going on, the bricklayers appeared, to give an estimate on building the chimneys and fire-places. One chimney was to be built double, to carry the two fire-places, one in the living-room below, and one in the library above. The other chimney was for the use of the furnace and the kitchen-range. Only local bricks were procurable, but they were of the best, including the hard firebricks used at the back of the fire-places. Mr. Rogers would have liked to have sent to Moose Jaw for the grey Prairie bricks, but the extra cost and time had to be considered. The contract price was $350 for both chimneys and fire-places, including the tiling in the hearths. To keep the roof from leaking, where the chimneys protruded, the masons inserted pieces of flashing, made of zinc, between the bricks; and these the shingler bent

under each shingle. He also used flashing to join the valleys where sections of the roof met. The larger strips of flashing were cut from galvanised iron, which came from Oshawa, Ontario, and which had been made by dipping thin sheets of iron into melted zinc.

Before the bricklayers were finished, the plasterers arrived to procure a contract. All had the same price, 45 cents a square yard for lathing and two coats of plaster, with nothing deducted for openings. The contract was let, and the lathers were to come as soon as the house was wired and the plumbing installed. One day the building inspector came along to see that the house was not within four feet of the edge of the lot, that the cement foundation was eight inches thick, and that the boards under the cement-work of the hearth upstairs were removed before the plasterers came.

Wiring the house for electricity finally cost $230, and the work was delayed a week, because at this juncture it had to be decided whether an electric range was to adorn the kitchen; for a saving could be effected by having both jobs of wiring done at the same time, as a special wiring for the range would cost $50. Mr. Rogers held out loudly and strongly for the coal range to which they had always been accustomed; but the cleanliness and ease of cooking by electricity were strong arguments to overcome. "Where am I going to sit on cool evenings in the fall, before the furnace is going? And how are you going to have hot water for washing and taking a bath?" he demanded.

"City people do not sit in the kitchen, but by the fire-place," his wife informed him, "and the water-tank is heated by an electric plunger, costing only four dollars a month to have all the hot water you need."

The farmer had used his best argument, and lost. The electrician advised side lighting in the living-rooms, and numerous outlets for the vacuum-cleaner, floor-waxer, toaster, curling-irons and reading-lamps. Mr. Rogers said that they would have bought on a side-hill, where they could have had running water and made their own electricity, if he had had any idea that they were going to use so much. There were now

so many different things to oversee at the same time, and so many people to interview, that Mr. Rogers hid his hammer and saw, and attended to supervision. He had decided on a hot-air furnace, as it was considerably cheaper; but his wife preferred hot-water heating, and she rightly argued that, as a woman has to keep the house clean, she should have a deciding voice in the choice of heating. "But the plasterers are coming next Monday, and pipes have to be laid in the walls for hot-water heating," he argued. Next day the contract was let for hot-water heating at a cost of $980, and extra pipe-fitters were put on the job, to rush it through. The boiler and pipes were made in Brantford. In planning the heating, the contractor figured carefully the number of cubic feet of space in each room, the size of window openings, and the amount of radiation required. It was not until after the boiler was installed that Mrs. Rogers learned that they might have had a fuel-oil boiler for a few hundred dollars more. The plumber had taken a contract before the electrician, and just when he laid all his pipes in the wall, or how many men he had working on the job, Mr. Rogers was never quite certain, with so many strange workmen coming and going. However, the plumbing inspector and the wiring inspector arrived at the same time, carefully inspected the work, and nailed up their cards on the walls.

Before the week was over the window-frames arrived, as they had to be set in before the house could be lathed, on the inside for plaster or on the outside for stucco. As the sash factory needed considerable time for such a large order, the contract for the windows was let while the shingler was on the roof. The price for the window-frames and windows was $580, which allowed for four large plate-glass windows, all the glass being shipped from Montreal.

The next week the lathers arrived, as quick in movement and deft in handling nails as the shingler, and on the same day the trucks brought the material for the rough plaster, and in the afternoon a mason arrived to mix it. Rough plaster is made of burned lime, sand and wood-fibre. Limestone is common all over Canada, being found even on the prairie, but the wood-fibre comes from the pulp-mills of Eastern

Canada or the Pacific Coast. The finish coat of plaster, applied after the first coat has thoroughly dried, is made of gypsum, which comes from Windsor, Nova Scotia, and other parts of the same province, and from New Brunswick.

It was decided to cover the outside walls of the house with stucco; so the same masons took the contract for two coats of stucco with cedar laths and tar paper for $1 a square yard, the tar paper being made in Victoria. While the plastering was being done, the carpenters built the inside basement steps, the back steps, the garage and chicken-house. At the same time Mr. Rogers bought oil shingle-stain, made in Victoria, and stained the roof, as the hot sun of July is very drying to bare shingles. He used ten gallons of stain at $1·50 a gallon, applied by a paint-brush made in Toronto.

As soon as the putty-coat of plaster was dry, the windows were set in and weighted, except the plate-glass ones, which were stationary. The window-cord, purchased at the hardware store, came from Hamilton, and the iron weights as well. The two bath-tubs, wash-basins, kitchen-sink, toilets and set-tubs were purchased at the plumber's store. There were fittings of excellent value of British make, but Mr. Rogers insisted on those from Amherst, Nova Scotia. The rough plumbing, added to the installation of these accessories, was $123 less than the cost of the heating.

Now the house began to shape toward completion. The finish lumber arrived, the doors were ordered from the door factory, the hardware from Toronto appeared for the doors, the fir floors were laid, and the contract let at 50 cents a square foot for hardwood floors for the front hall, living-room, dining-room, sunroom and library upstairs. The hardwood was quarter-oak from the forests of Ontario, milled and finished at Toronto. The woodwork was painted inside and out by Mr. Rogers, the paint, made in Victoria, costing him only $40. The work of painting the window-sashes was arduous indeed, but the task of cleaning the windows afterward was even more so. The walls inside could not be decorated until the plaster settled and spread, so it was decided to leave them white for the first two years. The radiators, from Guelph,

were set in, painted, connected up, the water turned on and the heating tried out. The electric-light fixtures were purchased at a bargain by the two daughters, and the house was pronounced finished.

Mr. Rogers now found that, as the house had cost more than he had anticipated, he would be short of cash for living expenses when the bills were all settled, so he arranged with an insurance company for a straight mortgage of $3000 on the property, bearing interest at $7\frac{1}{2}$ per cent.

Cleaning and grading the yard was a busy week's work, although Jack, as it was his last week before the opening of school, helped his father considerably. Then came the fateful day, when Mr. Rogers, while looking through the house, let his eye rest on a light-fixture above him, and a sudden suspicion came to him that something was wrong. Climbing on a step-ladder, he reached the fixture and examined it closely. His yell of anger hastily summoned the boy, who was just in time to see his father tear down the fixture, hurl it on the floor, and then overbalance and fall heavily beside the broken porcelain. While helping his father up, the lad noticed on one of the broken pieces the words *Made in Germany*; so no further explanation was needed. He led his father away in a dazed condition, and a doctor was summoned.

The medical man examined his patient carefully, and then said: "Mr. Rogers, you are a sick man. Your blood pressure is high, your arteries are hardened, and you are on the verge of a nervous breakdown. This rushing, business life of the city is too hard on you. You should retire, get out of the city, have a change, go away to the country where it is quiet, and get built up on a farm, and you will live a long time yet."

"Well, well," said the farmer, "those are the truest words I have heard for some time. A doctor is one man that must be obeyed. Jack, you stay here and be a doctor, too. I have just time to catch the night boat for Vancouver. To-morrow I will be on the train back to the prairie, and will be in time yet to help the boys with the harvest."

PROBLEMS

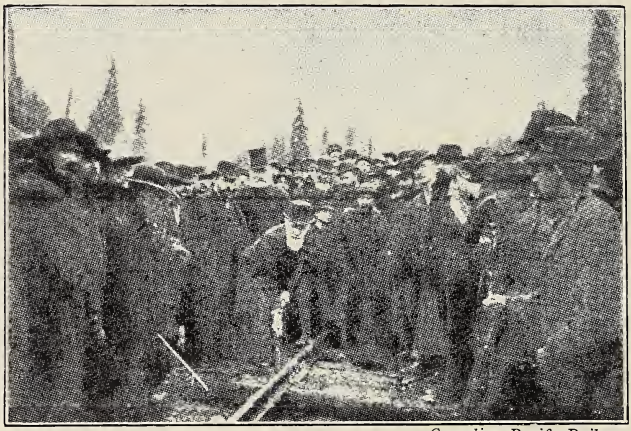
1. What was the sale price of the two farms disposed of by Mr. Rogers?
2. If the neighbour made his payments regularly, what will his last payment amount to, with interest at seven per cent?
3. How much was paid for the home site in Victoria?
4. What was the depth of the land in feet?
5. How much would it cost to fence it at $6 a rod?
6. What was the agent's commission?
7. What was the total amount received by the owner for the land?
8. What per cent commission would the architect have charged?
9. How much did the blue-prints cost?
10. Mark where the fire-place would be on the upstairs plan.
11. How much did Mr. Rogers pay for the building permit?
12. Make a list of all the people who took contracts for work on the house and arrange them in the right order.
13. What was the cost of putting in the cement foundation?
14. How many square feet were in the roof?
15. From the plans and story find the cost of laying the hardwood floors.
16. How many square feet did a gallon of shingle-stain cover?
17. How much was spent for plumbing?

57. THE CANADIAN PACIFIC RAILWAY

On November 7, 1885, a band of conquerors gathered to celebrate one of the greatest victories of all time. In that group assembled at the little station of Craigellachie, in the wild waste of the Canadian Rockies, was many a battle-scarred veteran, whose hair was whitened by the snows that never fade. No booming of cannon announced their triumph, for theirs had been a peaceful conquest of Nature. They had fought against the storms of winter, they had tunnelled great mountains, bridged yawning chasms, rent huge rocks asunder, and had completed the greatest engineering work of all time, the building of the Canadian Pacific Railway. The driving of the last spike,

on that memorable day at Craigellachie, signalled the commercial confederation of Canada, and fulfilled the promise given to the province by the western sea, when it joined with Canada, to make one great dominion, extending from shore to shore.

Craig Ellachie is a huge rock that stands in a lonely Scottish glen, and as the clan went to battle, the wind through the pass



Canadian Pacific Railway

DRIVING THE LAST SPIKE

Lord Strathcona holds the sledge. The black-bearded man behind him is Van Horne.

seemed to whisper the war-cry, "Craig Ellachie, stand fast." So when the last dollar was gone, and the road scarcely under way, when the money-lenders, thinking the scheme impossible, would not risk a cent on the venture, when the new company was facing failure and ruin, and the two Scotchmen, Donald Smith and George Stephen, the great captains of industry who planned the road, had given all their own money and had even mortgaged their furniture, one wired the other the famous message, "Craig Ellachie—stand fast."

The ceremony was brief, as these were men not of words, but of action. All agreed that the sledge should be handed to

Donald Smith, known to us all as Lord Strathcona. He gave his overcoat to a bystander, took the sledge and fixed his eye on the iron spike. The small boy who was water-carrier to that section was in the front of the picture to see that the spike was well driven. When these men, who had overcome such great difficulties, suddenly realised that their task was completed, they stood for many seconds in silent awe, until the small boy gave a great yell, which broke the spell, and cheer on cheer echoed through the mountains. Van Horne, the man who actually built the road, was asked to make a speech. While there were volumes to tell, and any politician would have spoken for two hours, the great builder simply said: "All I can say is, the work has been well done in every way." What greater praise could he have given all those men who had carried out his orders?

Before the conductor, at the proper moment, shouts, "All aboard for the Pacific!" and the picture is broken, let us look at the different men in the group who were responsible for the building of the Canadian Pacific Railway.

Naturally the eye first rests on Lord Strathcona. At the age of eighteen he left the land of the heather to enter the service of the Great Fur Company. The twenty best years of his life were spent on the bleak shores of Labrador, but finally he became head of the company, and was a member of the House of Commons in Winnipeg when Manitoba entered confederation. Before the building of the Canadian Pacific Railway the way east from Winnipeg led through the States. At St. Paul, Mr. Smith met James J. Hill, a Canadian, then in the coal business, who saw a future in railroading, and later built the Great Northern through to Seattle. Mr. Hill needed capital to buy a road that a Dutch company had built from St. Paul to the Canadian border, and Mr. Smith interested in the venture his cousin, George Stephen, who was president of the Bank of Montreal. Stephen was one of those Scotch wizards of finance who could pick dollars off a bush, so he organised a company, bought the road, and with Smith and Hill made millions from the grant of land that the railroad received.

When the fathers of confederation planned an empire from

ocean to ocean, their dream could only be fulfilled by banding the country together with steel rails. To build such a road seemed sheer folly to many people of Eastern Canada at that time, when there were few settlers west of Lake Superior, when the prairie was regarded as a wide and worthless waste, and the towering Rockies were not even explored. "Even though there was money enough in the world to build such a road," they declared, "it would not pay for the grease on the wheels." But as the United States had bought Alaska in 1867, and would have an interest in acquiring Western Canada, the prairie-lands were purchased from the Hudson Bay Company, and British Columbia was promised the road for entering confederation.

The Canadian Government started to build the road in sections. An American company took the contract to build from Port Moody to Kamloops. They claimed it was impossible to secure white labour, and brought the first Chinese to British Columbia to work on the road. The Government also built the line from Winnipeg to Lake Superior, which was a great benefit to the Red River settlers in Manitoba. But the cost of construction was so great, and the need of the complete road was so urgent, as none of the separate parts could be of great use, and as the voice of British Columbia, in angry protest at delay, resounded over the mountains, that Sir John Macdonald, the Premier, and Sir Charles Tupper, the Minister of Railways, decided to induce some company for cash and land grants to construct the great steel road.

These two travelled to England, but could not interest capitalists there in such a doubtful venture. Then Donald Smith, George Stephen and James Hill formed a company, and arranged with the Government to build the road. They were to be given the 700 miles already built, $25,000,000 in cash and 25,000,000 acres of land within twenty miles of the main line west of Winnipeg. They were to pay no import duties on material used in construction, no taxes on their land for twenty years or on their railway property for all time. It has often been claimed that the land grant was too large, but we must remember that land on the prairie at that time was only

50 cents an acre, and was raised in value by the building of the road.

We have already spoken of William Van Horne, one of the greatest builders of all time. In the illustration he is the black-bearded man with hands in pockets, behind Lord Strathcona. When the company was organised, Mr. Stephen became the president, and his first task was to find an expert railroad builder. Mr. Hill suggested the name of Van Horne, who was manager of a big road in the States, and this wonderful man, of Dutch ancestry, came to Canada, looked over the situation, saw the great future in opening up a new land, and took on the work, because its seeming impossibility challenged his skill and daring. There are a few such men in every age, who do not measure their work in terms of money, but in the glory of accomplishing a task worthy of a giant.

The contract was signed in 1881, and the company was given ten years in which to build the road, but when Van Horne arrived in Winnipeg as general manager in January 1882, he realised that it must be finished in half that time, so it could soon begin to earn money to pay the huge interest on the borrowed capital. He next decided that the road should run through Canada on the north shore of Lake Superior, instead of crossing south through the United States, as James Hill expected. This change of plans caused Hill to retire from the company, but it made the road a Canadian project. The course through the Rockies was also to be decided. Sir Sandford Fleming, the great Canadian engineer, had advised the Government of the easier grade through the Yellowhead Pass, but Van Horne decided to use the difficult Kicking Horse Pass, for four good reasons. It saved 125 miles, and distance means time; it opened up the fertile valleys of the Columbia and Okanagan; it cut off American roads from the south; and last, and most important, it gave access for all time to the world's grandest scenery. The fares of ten million tourists would pay for huge tunnels, snow-sheds and better grades.

So Van Horne was a man of vision, and he knew how to build a road. The standard he set was the despair of contractors. He criticised, abused and discharged the unworthy builder,

he urged the willing to do twice as much, he climbed over dangerous trestles to see whether they were properly built, and he drove engines over temporary bridges at the risk of his life. There were many sides to his nature. He was a good public speaker, could entertain lavishly, and was an artist of ability. He would often interest a group of labourers on the plains by sketching with charcoal on the whitened skulls of buffaloes.

In the summer of 1882 Van Horne planned to build five hundred miles of road on the prairie. This meant the completion of over three miles a day, through the short summer. Think of the supplies that were gathered at Winnipeg the winter before: rails from Britain, lumber from Minnesota, stone from the quarry and ties from the forest! Think of the great force of three thousand men and five thousand horses! Think of the three miles of high ballasted road, carrying work-trains with material, where the day before there had been only the grassy plain!

Van Horne sent to the States for a young man named Shaughnessy, whom he appointed as manager of supplies. This wizard of finance made one dollar do the work of two and saved the credit of the company during those days of construction.

The building from Sudbury to Fort William was a difficult task. In some places the road cost half a million dollars a mile. Factories for the making of dynamite were built along the road; twelve thousand men and five thousand horses were employed, as well as a wonderful track-laying machine. This part of the road took three years in building, and, before it was completed, the great task of the mountain section was undertaken. All available money was spent, the land grant was not saleable, as settlers could not come in until the road was built, so the company faced ruin. There came a day when the pay car could not go out, as there was no money. So great was the undertaking that the Government and the country as well were on the brink of disaster. Twenty million dollars were unwillingly loaned by the Government, and this sum was soon expended, leaving the company in a worse state than before, because it owed more money, and the road was far from completion.

The company was saved by a miracle. Sir Charles Tupper had persuasive ways, and he appealed to Lord Revelstoke, of London, who agreed to raise $30,000,000.

When the news reached Canada there was great rejoicing among the staunch men who had stood fast against such terrible odds, and everyone felt that Canada was saved, and that on the new line there would be a town called Revelstoke, and a station named Craigellachie.

Then the tide turned. Scarcely was the road finished when the Saskatchewan Rebellion broke out, and troops were hurried over the new line to save the lives of settlers from the Indians in the far West. The road had served the country in a great need.

When the rails met in 1885 much remained to be done. To pay operating expenses, the West must be peopled, and, in this great task, Van Horne showed the genius for organising that he had shown for building. At first he gathered the bones of buffaloes and shipped them east as freight, but soon his posters and advertising brought settlers, and wheat began to move eastward. Branch lines were built, elevators erected at Fort William, steamers sailed on the Lakes, and the company helped to finance the early settlers by buying their wheat.

In the mountain section, huge sums were expended in straightening curves, reducing grades, boring tunnels, and erecting snow-sheds. The Connaught Tunnel, 26,517 ft. long, was drilled through Mount Donald, at the highest part of the Selkirks, and finished in 1916, at a cost of $8,500,000. It has been famed as the largest tunnel in America. In British Columbia, 128 miles of the road are double-tracked.

With a fleet of liners on both oceans, the Canadian Pacific Railway is one of the greatest transportation systems in the world, employing a hundred thousand people, with a pay-roll of $8,500,000 a month. The prosperity of this great company is bound up with the welfare of Canada. In 1886, the loan was paid back to the Dominion Government, and huge sums each year are expended in adding to the service for a great and growing country.

"No. 1 Westbound" and "No. 2 Eastbound" are national terms, and Pauline Johnson hears the Westbound say:

> I carry the brave and bold—
> The one who works for the nation's bread,
> The one whose past is a thing that's dead,
> The one who battles and beats ahead
> And the one who goes for gold.

And the Eastbound says:

> I swing to the land of morn—
> The grey old East with its grey old seas;
> The land of leisure, the land of ease,
> The land of flowers and fruit and trees,
> And the place where we were born.[1]

58. THE CANADIAN NATIONAL RAILWAY

In one sense the Canadian National Railway is the oldest in Canada, as it includes as part of its system the old Grand Trunk and Intercolonial Railways, which date back to the middle of the last century; Canada being thus one of the pioneers of Government-owned systems of transportation.

For many years Canada had only one transcontinental railway, the Canadian Pacific, whose history is linked with the development of Canada west of the Great Lakes. A second ocean-to-ocean line was inevitable; and the veteran railway builders, Mackenzie and Mann, in the face of difficulties that would have proved insuperable to most men, planned and carried through the construction of the Canadian Northern, which, as the name implies, was to open up and serve the rich areas lying north of the belt of country developed by the Canadian Pacific Railway. There was a real need for such a railway; but its success was only assured if it had a monopoly of transportation over Northern Canada. This monopoly was broken by the Grand Trunk Railway, which ran a parallel line to the western coast under the name of the Grand Trunk Pacific.

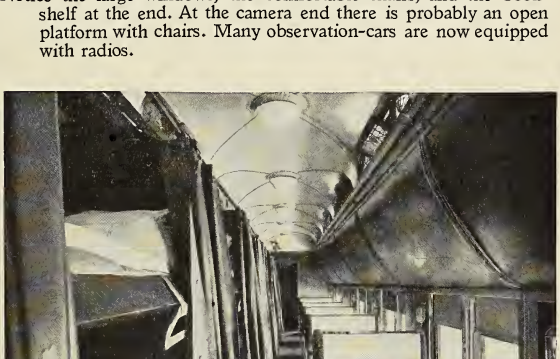
On the outbreak of the Great War financial ruin faced both

[1] From *Flint and Feather*, by E. Pauline Johnson.

Teachers' Trails in Canada

THE OBSERVATION-CAR

Notice the large windows, the comfortable chairs, and the book-shelf at the end. At the camera end there is probably an open platform with chairs. Many observation-cars are now equipped with radios.



Teachers' Trails in Canada

THE SLEEPING-CAR

This picture shows how an entire coach is a travelling saloon in the daytime and becomes a comfortable sleeper at night.

corporations. Their only hope was in amalgamation; but neither company was strong enough to buy the other out. At this point the Canadian Government stepped in and took over the rival systems as they lay locked in a death struggle, thus inaugurating the longest line of railway transport in the world. When linked with the lines already operated by the Government, and further increased by taking over the original Grank Trunk, the Canadian National possessed a mileage nearly equal to the equatorial diameter of the earth.

Much controversy has taken place in regard to the economic status of state-owned railways and other national services. But of this there can be no doubt: it would have taxed the administrative ability and financial resources of the wealthiest and most highly organised private corporation in America, to take over the network of lines which constitute the Canadian National, with all their liabilities and rival interests, and evolve a homogeneous, dividend-paying public utility. This has been accomplished in the case of the Canadian National, largely owing to the energy, native ability and fearless character of one man, Sir Henry Thornton.

The Canadian National operates in each of the nine provinces. From coast to coast it extends through all-Canadian territory, a fact which makes it of imperial as well as of national importance. Like all railways built for development purposes, its construction did not end with the driving of the last spike. As a business proposition it can only be made successful by creating trade, and to accomplish this under modern conditions requires much publicity. The methods of advertising employed are fully up-to-date; the use of radio, and the operation of Canadian National broadcasting stations across the continent, are points in evidence. One long ribbon of settlement followed the line of the Canadian Pacific Railway; another is forming along the lines of its friendly rival in the North. The mining and other natural resources of the Canadian Shield are being rapidly developed as a result of transportation facilities afforded by the Canadian National Railway. The same is true of extensive areas in the Prairie Provinces and in British Columbia. The only logical outlet for the products of the undeveloped

Northland, including the Peace River district, is by way of this line. At present it has seven tide-water terminals, five on the Atlantic coast and two on the Pacific, from which Canadian products are carried to many foreign ports by the fleet of forty-eight vessels that constitute the Canadian Government Merchant Marine. When the Hudson Bay branch is completed, the shortest possible route between Europe and the Orient will be over the rails of the Canadian National Railway.

59. THE QUEBEC BRIDGE

THERE is magic in the number three. If we fail twice, we expect to succeed the third time. One of the greatest bridges in the world spans the noble St. Lawrence seven miles above Quebec, but two terrible disasters occurred before the daring enterprise of man placed the great bridge in its present form.

The Quebec Bridge is one of the most difficult of the engineering works ever undertaken, and for many years, though the need was great, the difficulties of construction seemed impossible to be overcome. At the narrowest place the river is nearly a mile wide, and the channel in the centre is over two hundred feet deep, and of such a nature that no centre supports could be erected. The immense structure would have to be borne by supports placed so close to the banks that the centre span would require to be 1800 ft. in length, longer than that of any other bridge. It would also require to be 150 ft. above high-water, to allow the largest ships to pass beneath, and it must also bear the might of the heaviest trains without a quiver. When the second great transcontinental railway of Canada, the Grand Trunk Pacific, chose Quebec for its river port, the bridge became a necessity.

The Quebec Bridge Company was formed to carry out the undertaking, and the Phœnix Engineering Company of Pennsylvania contracted for the steel-work. The arm next the shore is called the anchor arm, and the part over the river is called the cantilever arm. When both sides were in place,

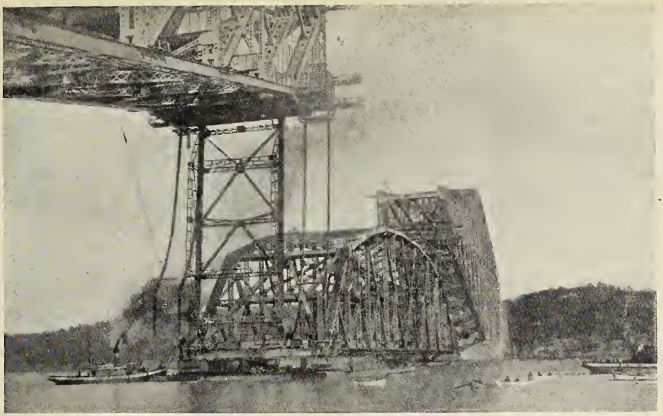
a centre span 640 ft. in length was to be raised from the river and fastened to the two arms.

On August 29, 1907, one huge arm was nearly completed. Work-trains carried the men and materials to the very end of the cantilever. A few days before, the chief engineer had come to Quebec to inspect the work. He was doubtful whether it was being built strong enough. On reaching home he wired to stop all work until a test was made, but a mistake was made in receiving the telegram. That was on August 29. That night at six o'clock the great arm collapsed and fell into the river, carrying with it a work-train and seventy-five men, all of whom were drowned.

The Government came to the aid of the Quebec Bridge Company, and a new bridge was planned. It took two years to clear from the river the wreckage of the old bridge. The new piers were built, the anchor and cantilever arms were in place on both sides, but the huge gap of 640 ft. in the centre remained.

On September 11, 1916, the last work on the great bridge was to be carried out, the raising of the huge span to join the arm. Resting on barges, this framework of steel was towed directly under the bridge. Cheering crowds lined the banks. Flags and streamers were flying from small craft on the river. Whistles shrieked as the powerful engines stationed at the ends of the arms began to raise the span, weighing five thousand tons, from the river, 170 ft. below. When the mass of steel was moved up a few feet the barges were removed. Then, without the least warning, a terrible thing happened. The span trembled, lurched and suddenly plunged, a crumbling mass of twisted steel, into the depths of the river. Fourteen men on the structure lost their lives.

Then, on September 17, 1917, a similar span rested in the same spot. The onlookers held their breath, there was no cheering, but the great span went slowly up and, in four days, reached its final resting-place. Experience counted, for every error had been corrected, and patience and skill triumphed.



Department of the Interior

THE QUEBEC BRIDGE—I

Notice the tugs and barges. The centre span is about to be raised.

Canadian National Railways

THE QUEBEC BRIDGE—II

The complete bridge. Which is the anchor arm? The cantilever arm?

60. THE ST. LAWRENCE RIVER SYSTEM

In Canada the problem of transportation is a vital one. The settled portion lies largely on a strip of country only three hundred miles wide, but three thousand miles long from coast to coast, with the Canadian Shield and the Rocky Mountains as barriers on either end. The two principal methods of transportation are by rail and water; and the latter, used since the dawn of civilisation, is still the cheaper and better for the conveyance of commodities. While the speed of the locomotive is an advantage for passengers and mail, the steamer, as it moves with ease through the water, carries its cargo of thousands of tons, and wears out no road-bed in its passage. So, in the keen competition of modern countries in industry, a nation like England, which ships her goods by water, has a great advantage in the markets of the world over a country like Russia with little access to the sea.

Western Canada began to develop when settlers followed the rails of the Canadian Pacific Railway, and the grain area of the Prairie grew until wheat became the principal export of Canada. But the long freight haul by rail to the Atlantic seaboard was so costly, that the builders of our Dominion turned to the idea of transportation by way of the Great Lakes and the St. Lawrence River, the greatest inland waterway in the world, extending to the heart of the continent, but difficult to navigate, because of rapids and shoal-waters, and being closed by ice in winter. In the early days before the railroad, as the pioneer settlers followed the trail of the fur-traders, this great water system was the only means of transportation, so canals were cut, and the whole waterway was gradually improved, to keep pace with the growing needs of Quebec and Ontario. Up to the present time the total capital cost of the canal system is over $189,000,000, and is not yet complete. For though the western outlet by way of the Pacific through Vancouver and the Panama Canal is of increasing importance, and though rails are to be laid to command the use of Hudson

Bay, yet the people of Canada will never rest content until ocean-going steamships can sail up the St. Lawrence, through the Great Lakes, and dock at Fort William at the end of Lake Superior, in the very heart of Canada, for their cargoes of wheat.

Let us consider the improvements that have been made during the past century, and those that are yet necessary to this great waterway for through steamship navigation.

In 1830 only vessels drawing 11 ft. of water could reach Montreal, and they were often weeks making the trip

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THE PILOT BOAT AT FATHER POINT

Where is Father Point? Why does the pilot leave the ship here?

up the St. Lawrence from Gaspé, being towed up St. Mary's Current by teams of oxen, twenty-six or more to the team. In later years a deeper channel was dredged through Lake St. Peter, between Montreal and Three Rivers; and finally the channel was deepened to allow the largest ocean liners to reach Montreal, which now stands at the head of ocean navigation, and has become Canada's leading port. Although ice-bound in winter, Montreal ranks second in tonnage only to New York as an Atlantic port, and is the greatest wheat-shipping port in Canada. The harbour establishment of this, the greatest city in Canada, represents a capital expenditure of $45,000,000. The St. Lawrence route to Europe is of increasing popularity among travellers. The big oil-burning steamships make the

voyage from Quebec to Southampton or Cherbourg in six days or less—two days in the sheltered waters of the river and gulf, and four days at sea. An average of one passenger liner a day sails from Montreal to Europe, and the distance to Liverpool is only 2650 nautical miles, compared with 3040 from New York. In July the steamers turn from Cabot's Strait and pass through the Strait of Belle Isle. Two days on the sheltered waters give the passengers time to accustom themselves to steamship travel before the rough waters of the ocean are

Department of the Interior

SOULANGES CANAL

On the St. Lawrence. How many locks do you see?

reached. Crossing the Atlantic in summer at 52 degrees N., the ship enters the fine-weather belt, there is no fog, and the days are long and cool.

Between Montreal and Lake Ontario the St. Lawrence is barred by the Lachine Rapids. To overcome this difficulty, the Lachine Canal was opened in 1825, with four and a half feet of water on the sills. It has been improved until at present it allows the passage of steamboats 250 ft. long, drawing fourteen feet of water. When the New Welland Canal is finished, the only barrier to the ocean ship on its way to Fort William will be the present Lachine Canal, so the last great engineering feat to make the scheme possible will be the enlargement of

this canal to give a draught of thirty feet, and the Government has the project already under consideration.

In the route from Montreal to Fort William, a distance of 1214 miles, there are seventy-four miles of canals, with forty-nine locks. One of the most important parts of this system is the Welland Canal, built across the Niagara Peninsula, between Lake Ontario and Lake Erie, to overcome the formidable obstruction of Niagara Falls. The first canal, com-

Department of the Interior

SAULT STE. MARIE LOCKS

Which do you think is the Canadian side? Why? Assuming that you are right, on which side of the closed gates is the water higher? Why are the gates next the camera open?

pleted in 1833, and considered so wonderful by the people of those days, would seem very crude beside present canals. It would not admit large steamers, as its forty wooden locks were each only 110 ft. long, 22 ft. wide, and carried but 8 ft. of water above the sills. As Canada's trade has increased, and as the West has been developed, the Welland Canal has constantly been improved. Concrete has taken the place of wood in the locks, the canal has been widened, deepened and straightened, until at present it would hardly be known by its first builders, were they living. But the big grain freighters handling the lake traffic cannot pass through the locks only 270 ft. long,

so the wheat has to be unloaded into elevators at Port Colborne, and carried through the canal on smaller steamers. Now a new Welland Canal, which was begun by the Canadian Government in 1913, is nearing completion, and will cost nearly one hundred million dollars. It extends from Port Colborne on Lake Erie to Port Weller on Lake Ontario; is twenty-five miles in length; contains only eight locks, each of a forty-six-foot lift, 800 ft. long; and will pass the grain freighters of the lakes or ocean. The Welland River and some other parts of the old canal are being used, forty-five million tons of earth have been removed, and the barrels of cement required, if placed side by side, would reach from Vancouver to Halifax. A lock chamber can be filled in eight minutes, and a loaded freight vessel will pass through the entire canal in eight hours, instead of fifteen, as at present.

With the constant dredging of Lake St. Clair, and the splendid canal at Sault Ste. Marie, only the Lachine project remains to bring ocean traffic to the very centre of Canada during the summer months.

61. CANADA'S TRADE WITH OTHER COUNTRIES

Since 1900 Canada has given Great Britain a preference in trade by taking off one-third of the duty on all goods from the Motherland, and this favour is extended to other British Dominions. Newfoundland gets also free trade in fish and fish products, and we have special trade treaties with Australia and New Zealand. Twenty-one per cent of our imports are from British countries, who buy, however, forty-four per cent of our exports.

From England are imported cloth, cutlery, porcelain, tea, special machinery, shoes, and various kinds of manufactured goods, while England buys from Canada wheat, flour, cattle, apples, bacon, cheese, minerals and lumber.

Canada sells Australia paper, farm machinery and automobiles, and buys butter, mutton and wool. However, the trade is not extensive between the two countries, because of

their great distance apart and because they produce raw material of a similar nature, as wheat and animal products. Large quantities of raw rubber are imported from the Straits Settlements. An extensive trade is carried on with the British West Indies, with which a weekly steamship service is maintained under a subsidy by the Canadian Government. The southbound ships carry potatoes, flour, codfish, tinned milk and canned fruit, and return with sugar-cane, raw cocoa and tropical fruits.

Canada trades more extensively with the United States than with any other country, buying 67 per cent of all her imported goods from her southern neighbour, and selling in return 37 per cent of her exports. The imports are raw cotton, anthracite coal, petroleum, fruit, clothing, motor-cars, raw material for American branch manufactories in Canada, and manufactured goods of every description. The Americans buy from us paper, wood-pulp lumber, logs, milk, iron ore, beef, hides, hard wheat for milling, asbestos, nickel, and various minerals in the unrefined state.

Raw silk, tea and rice have long been imported from China, but recently a new trade has sprung up in the Orient, since Vancouver has become a grain-shipping port, and China and Japan are buying large quantities of wheat, flour, lumber, construction paper, fish and fish products.

In order to have a favourable trade balance with other nations, a country must export more than it imports, and in 1926 Canada had a trade balance of $275,000,000 on the credit side, a better showing, in proportion to the amount of trade, than that made by any other country. The Dominion maintains an active Commercial Intelligence Service, with trade commissioners in the principal export markets for Canadian products. Canada's export trade amounts to $140 *per capita*, the following being the main exports in the order of their value in 1926:

EXPORTS, 1926

	$
Wheat	364,201,000
Paper	110,105,000
Wheat-flour	69,688,000

EXPORTS, 1926—*continued*

	$
Planks and boards	66,824,000
Wood-pulp	49,910,000
Meats	37,112,000
Fish	36,800,000
Automobiles	35,717,000
Cheese	33,719,000
Gold, raw	25,968,000
Oats	24,238,000
Barley	23,182,000
Sugar, refined	19,981,000
Cattle	18,081,000
Furs, undressed	17,198,000
Tires, rubber	14,004,000
Copper ore and blister	13,946,000
Lead	13,928,000
Pulp-wood	13,628,000
Farm implements	13,056,000
Flax-seed	12,883,000
Nickel	12,829,000
Silver	12,366,000
Laths, palings and pickets	11,266,000
Asbestos, raw	10,000,000

One cannot be long associated with export trade without gaining a substantial idea of its importance to Canada. Nor can one be engaged in it without being impressed by its romantic side.

Over a hundred years ago export trade was the one vital element in the trade of Nova Scotia. She exported then, as she does to-day, her fish and lumber in her own ships. Nova Scotia fish found its way into Spain, Portugal, Italy, the West Indies, and South American countries. In addition to return cargoes, Spanish doubloons and pieces of eight, such as we read of in treasure-hunt and pirate stories, came back to Nova Scotia, and actually formed the principal currency in Halifax and the surrounding districts. This export trade provided work for many people, and the profits formed part of the initial capital for the establishment of widely known Canadian banks.

Samuel Cunard, a citizen of Halifax, gained his experience in shipping in this port, and afterwards founded the world-

Department of the Interior

SHIP-BUILDING AT VICTORIA, B.C.

Department of the Interior

WINTER BERTHS AT ST. JOHN, N.B.

famous Cunard Line, which plays a great part to-day in trans-atlantic commerce.

Since that time the importance of export trade has become a matter of national concern. British Columbia rivals the Maritimes in her exports of lumber and wood products, paper and fish—in her case largely halibut and canned salmon—and exceeds the Maritimes in the exportation of mineral products.

The prosperity of the western farmers depends to a great extent on the export of grain, either as grain or as flour ground in Canadian mills.

Although the export trade of the provinces mentioned attains very great proportions, the timber and mineral resources of Ontario and Quebec, and the wide variety of general manufactures, cause Ontario and Quebec still to retain a commanding lead in volume and value of goods exported.

Canada's exports from March 1925 to March 1926 were valued at over one billion three hundred and twenty-eight millions of dollars. That's a lot. Count it up in millions and you have to go over the thirteen-hundred mark.

Our actual favourable balance for that twelve months was $401,134,000.

In other words, as a result of our export trade, new money, found money, earned money, call it what you like, came into Canada for further productive use to the extent of over forty dollars for every individual in the Dominion.

Export is a stabiliser of trade. Cement made in the fall and early winter is shipped to countries south of the equator, where building operations are heaviest in our winter-time. On account of this same variation of seasons, agricultural implements for Canadian use are made in our winter, and for export in the summer. Tires, rubber clothing and footwear alternate by seasons in Canada, and in the reverse seasons abroad.

Trade depressions, which recur from time to time in every country, do not usually occur in different countries at the same time. To the producers who are doing export trade of considerable proportions, trade may be a bit flat in Canada, but Australia, Great Britain, South Africa and the Argentine send along their orders as usual, and the exporting concerns

are able to keep their staff together, cut down factory overhead, and show a better average in financial statements over a period of years than those whose business is subject to the fluctuations of the purely domestic market.

It is not only every district in Canada that is affected directly by export trade, but also practically every country in the world. Canadian goods find their way in some quantity into 137 countries or geographical divisions throughout the world. Substantial business is done in forty or more of these, and business running into the hundreds of millions with the United States and Great Britain. Other parts of the British Empire, and the Argentine, Belgium, China, Japan, France, Italy and Holland, are outstanding customers.

The lumber-camp cook in Sweden rectifies his tea with Canadian condensed milk, and probably the lumberjacks kick about the frequency of pancakes and beans of Canadian origin on the menu—for their frequency only. Argentine ranches are fenced with Canadian wire, and their fields tilled with Canadian implements. Brazilian peasants observe feast days and fast days by consuming good old Canadian dried codfish. Mining machinery in South Africa is kept in motion by Canadian rubber and leather belts. Maoris and New Zealanders alike ride to school on Canadian bicycles. The winter tourists in Switzerland use skates, toboggans, shoe-packs and knitted garments turned out by the same concerns that every good Canadian knows so well. Brazilian railways run on Canadian rails supported by Canadian ties. Newspapers in dozens of countries, with many millions of circulation, keep the Canadian woodsmen and farmers busy all winter cutting pulpwood. Theatre curtains the world over would not be fire-resisting but for Canadian asbestos. Indian potentates are driven in stately limousines and Straits Settlements brokers drive automobiles of the make with which we are all familiar.

Arctic Circle furs trim the gowns of milady in Paris. Crusts of loaves made from Canadian flour keep the wolf from the door in thousands of European and Asiatic homes. The proverbial British breakfast of bacon and eggs would be much reduced but for Canadian products.

Nickel, brass, copper, aluminium, iron, silver, cobalt and gold from Canadian mines and mills find their way to hundreds of metallic uses throughout the world. The happy farm-houses of New Zealand resound to the harmonies of Canadian musical instruments, and every Monday sees Canadian clothes-pins holding up the weekly wash.

Delicious maple syrup intrigues the appetite of many European epicures, and toothsome chocolates, of a kind that Canadians have made peculiarly their own, provide delectable sweetmeats for Hindus, Arabs, Chinese and Anglo-Saxons. It is not unlikely that the silk hat you saw on the head of a Zulu chief in the Prince of Wales's picture was of Canadian production. Canadian shoes made from Canadian leather march over Canadian linoleum at the Canadian Court of the New Zealand Exhibition in Dunedin.

Some of these items may seem to be the curiosities of trade. Rather, they are simply a proof that nothing is impossible. Not long after the war we were sending cotton goods to Manchester, and coal within a few miles of Newcastle.

62. WHEN THE POSTMAN COMES

When the postman comes all other interests are suspended until the contents of the mail are read, discussed, considered, and laid away for future reference and response. It gives one the feeling of having been neglected if the mailman passes by without calling. The mother thinks of her son in the far-off city, too busy to picture her lonely and waiting while she ever hopes for a message from the absent one. The business man hastily takes his handful of letters into the office and sorts them according to their value: first, the ones containing cheques or orders, opened eagerly; the statements of accounts due, to be opened next with trepidation; and those carrying advertising, to be scanned hastily above the waste-paper basket.

In the small railway town there is always a proportion of the inhabitants who repair to the station to see the mail-train

arrive, follow the mail-sacks to the post office, and wait for the sorting of the letters. Rural delivery brings the newspapers as well as letters, and the farmers seize a few moments to scan the mail and follow the course of events in the great outside world. Bearers of the mail, in storm and sunshine, in winter and tempest, you bring us, in the service of the king, tidings of joy and words of sorrow, messages from dear friends, the serious charges of business, and, on the glad eve of Christmas, the tokens and remembrances of the season of cheer.

The care of the mail is the largest business undertaken by the Canadian Government. The country is divided into fifteen districts, which embrace an area greater than that of any other postal service in the world except the United States and Russia, the revenue being nearly thirty-three million dollars annually. Besides handling 500,000,000 letters yearly, the post office transfers $146,000, as well as newspapers, periodicals, mail-order goods for stores, and parcels of all kinds. Mail is delivered in cities by the postman on foot; elsewhere horses and wagons, autos and dog-teams are used; steamships, trains and aeroplanes carry the mail from place to place, time being the essence of the agreement between the Government and its nine million customers. When one drops a letter in the mail-box, his care of it ends, but expert sorters start it on its journey, and fast trains hurry it to its destination, until it reaches the person to whom it is addressed. Through blinding snowstorms, over lonely trails, delayed not by the floods of springtime or the rains of autumn, the mail has precedence over all other traffic.

The postal department of Canada has maintained a splendid tradition in conducting a mail service that is not excelled in any country in the world. As early as 1721 mail was delivered between Montreal and Quebec, but the regular post office was first established in Canada in 1763, when Benjamin Franklin organised the service for the American colonies. The first exclusively Canadian postal service, however, dates from 1788, and was conducted by the British Government for the provinces. The rates were very high, a letter from Toronto to Montreal costing a shilling, and one to England four shillings. In 1851 each province undertook its own mail service, when the postage

was reduced, first to 6 cents and later to 5 cents. At Confederation the provincial systems were transferred to the Dominion, with a further reduction to 3 cents a half-ounce. In 1897 the postal service was reorganised with a two-cent rate, but during the Great War the three-cent rate was restored, until July 1, 1926, when the two-cent rate became effective once more.

After the outgoing letters in a large post office are faced up, and run through the cancelling machine at the rate of hundreds per minute, they pass into the hands of the sorters, who are trained experts, and must pass each year both written and oral examinations, on which they are supposed to make 85 and 90 per cent. A sorter must know possibly three thousand post offices, or all the streets and blocks in a city, and be able to sort the letters with accuracy and dispatch. Sorters work in the mail-cars as well, and make up the mail between stations.

While some letters are addressed too fully, as Toronto, Ontario, Canada, the last name being unnecessary, many contain such a meagre address as to cause the sorters a vast amount of additional work. A letter addressed to William Young, Winnipeg, may, with the aid of the directory, find its rightful owner, but many letters written by foreigners to immigrant friends and relatives are addressed in a foreign language, by people who have a very indistinct knowledge of the correct name of the post office. A most difficult letter to place is one on which the sender has put the street, but has forgotten the town and province. In this case the sorter has to consult numerous directories of different cities.

New departures of the post office are the parcel post, which gives a cheap rate on parcels up to ten pounds, according to the mileage within provinces; the C.O.D. system, which collects the purchase price on mail-order goods and repairs; the classified mailing-lists furnished to business houses for advertising purposes; and the system, which lessens the work of the Christmas mailer, of the clerk's pasting on the postage when he weighs the package, instead of the sender having to buy and affix his or her own stamps. Another pleasing innovation in the post offices is the porcelain stamp-moistener, which obviates the unpleasant task of licking postage-stamps.

By a constant study of the needs of its customers, a desire for efficiency and service, and the practice of strict economy, the Government has shown that it can conduct a huge business enterprise with as great success as any private corporation in the land.

63. THE BUILDING OF THE "GREAT EASTERN" AND THE LAYING OF THE ATLANTIC CABLE

Let us introduce to you Isambard Brunel, a great man of England, whose name does not appear in our history, but whose work will endure for ages to come. He was a great engineer, who built tunnels and bridges, and the first great ocean steamships. As a boy, his play was concerned with tape-measures, models, decimals and geometry. He lived from 1806 to 1859, a time of great development in steam-power and in the use of iron in the place of wood.

Steamships were a doubtful venture at first, but when the *Great Britain* was wrecked on the Irish coast it was found that iron sides withstood the fury of a storm where a wooden vessel would have been pounded to pieces. Another difficulty was in carrying sufficient fuel to drive the engines on long ocean voyages from England to India, before the Suez Canal was built and coaling-stations established. It was to overcome this last difficulty that Brunel planned a huge steamship, six times as large as any vessel then afloat, nearly the size of the great *Aquitania* of to-day, and considered as one of the wonders of the world for a quarter of a century.

This ship was the famous *Great Eastern*. She was 680 ft. long, and full-rigged with six masts. She was divided into ten watertight compartments, was provided with a double "skin," and was fireproof, and her instruments were more accurate than any previously known. She was built at Millwall, England, and was four years under construction. So huge was this ship that it took three months to launch her down the slipways into the water.

As a business venture, the *Great Eastern* was a complete failure. She burned 360 tons of coal a day, and made only thirteen knots an hour, and in those days it was impossible to secure the great number of passengers and the huge amount of cargo necessary to cover expenses for a voyage.

This famous ship did her best work in the laying of the Atlantic cable. Before 1845, the telegraph was not extensively used in England, but in that year it was the means of arresting a murderer, and from that time its future was assured, and telegraph-poles rose rapidly over the land. During the next year it was found that gutta-percha could be used to insulate wires, so that electric currents might be sent through them under water. After sending messages through a cable from Dover to Calais, the daring feat of laying a cable from Europe to America was undertaken.

After two failures, in 1865, the *Great Eastern* was chartered for the task, and took aboard 2300 miles of cable, coiled in three iron tanks. The cable was connected with the shore-end at Valentia Island, Ireland, and the great ship, guarded by two men-of-war, steamed off for Newfoundland. During a storm, when the vessel was a thousand miles from Ireland, the cable snapped, and, although twice hooked by grapnels, the lifting machinery was not able to raise it to the surface. The sea was so rough that the cable was dropped back to the floor of the ocean, and the undertaking was given up for the season.

In 1866 the *Great Eastern* left Sheerness with a new cable aboard, of greatly improved construction. A month later the cable was brought ashore at Heart's Content, Newfoundland. The first message was an interchange of greetings between Queen Victoria and the President of the United States. The *Great Eastern* then sailed to where the former cable broke, picked it up, and joined it to a new cable which was connected with Newfoundland. After being used in laying cables from France to America and from Bombay to Aden, this great ship was beached in the Mersey, and broken up, but she is remembered as having taken part in one of the greatest enterprises of history.

The Pacific cable, the All-Red Line, from Bamfield, British

Columbia, to Sydney, Australia, via Auckland, was laid in 1902. Now a new cable has been loaded at Greenwich to parallel this old line. The length of the cable is 3500 miles, and its weight is 8500 tons. The length of the wire to be wound round the conductor would reach from the earth to the moon. The greatest depth of the ocean in the path of the cable is 3400 fathoms, or one and a half times the height of Mount Robson.

Earthquakes often snap ocean cables. Some lines last as long as sixty years, but those on rocky beds have to be frequently repaired. Raising a cable to the surface and repairing it is often a costly business. One job in mid-Atlantic recently cost nearly half a million dollars.

So great is our interest in the whole world that the oceans no longer divide us. We wait not for sails to bring us the news from afar. A message from the ends of the earth is flashed under the ocean and over the wire in less time than it takes a messenger boy to cross the street.

64. THE TELEPHONE

A MECHANICAL telephone was used in India centuries ago. But it was only by the application of electricity that the vibrations set up by the human voice could be transmitted long distances, and faithfully reproduced at the receiving end of the line; so the evolution of the modern telephone was dependent on the extent of our knowledge of that mysterious force. In the age of invention that gave us the telegraph, so many scientists were working along similar lines of experimental research, it is no wonder there were several claimants for the honour and emoluments attached to the invention of various electrical devices and appliances. Much controversy arose over the priority rights in connection with the invention of the telephone. But, without going into the merits of the case, we may conclude from the decision given in the courts that Alexander Graham Bell was the inventor of the modern commercial telephone. The city of Brantford, in western Ontario, is known

as the Telephone City, because it was here, at his home on Tutela Heights, that Bell perfected his invention. In the fall of 1876, he sent his voice over a wire strung from Brantford to Paris, Ontario, a distance of eight miles.

Little more was heard of the telephone for some years. Like many other men of genius and vision, Professor Bell was "not without honour save in his own country." In order to place his invention on a commercial basis, he removed to the United States, where he took out patents, formed a company, and laid the foundation of a large fortune.

The telephone was a success from the start. With the many improvements that have been made in it, and the extension of the field of its operation, it has become a public utility second only to that of rapid transit. To-day, a telephone is in every store and office of any importance, and very few modern homes are without this convenience. It has been an inestimable blessing to the dweller in suburban or rural districts. Many lives have been saved and disasters averted by messages sent over the 'phone. Instead of driving miles for a doctor, and bringing him to the bedside when it is too late, we summon him by 'phone, and he arrives in his car in time to save a precious life. Because of timely calls over the telephone, police and fire departments are able to do more effective work. Fire-rangers in forest areas are able to save the country many thousands of dollars by summoning aid in this way.

Its contribution to social intercourse is perhaps the highest function of the telephone. Very often misunderstandings are removed or prevented by the human voice, when written messages or chance meetings would fail; and how quickly a social evening or an outing can be arranged by this means.

Next to the United States, Canada has more telephones in proportion to population than any other country in the world. At present there is one telephone to every nine people, and the capital invested in Canadian telephone systems is over $174,000,000. Though the system of calling "central" to connect you with a given number is still generally used, automatic telephones are being installed in many large industrial plants and business houses, as well as in a few cities. By this

method you turn a dial in very much the same way as you manipulate the combination of a safe, or as you tune in to a certain station on your radio. The radio, by the way, is likely to supersede the telephone in the sending of long-distance messages, if it does not altogether supplant the older system.

65. THE AEROPLANE AS AN AID TO INDUSTRY

Though it is not likely that the aeroplane will supersede steamships, railways and motor-cars in case of the major traffic and transportation requirements of this country, there are many important ways in which the aeroplane will be found indispensable in the development of industry, and in the maintenance of certain Government services, such as topographical and geological surveys, prevention of forest fires, detection of smugglers, and protection of fisheries.

The Royal Canadian Air Force, though operating under the Department of National Defence, has been keeping in practice by carrying out important work connected with various branches of the civil service. For several years the Topographical Survey Branch of the Department of the Interior has been engaged in the work of mapping parts of Canada containing important natural resources. When complete, this aerial survey will take in the whole of the Dominion. To perform this work by making surveys on the ground requires much time and involves much expense. The call for speed in the production of a topographical map is sometimes imperative, as when a rich strike has been made, and a new mining area is to be opened up. Mapping by means of photographs taken from planes has more than speed and economy to recommend it: the resulting maps are more accurate and complete in regard to the details that are of most use to prospectors, lumbermen, hunters, trappers, tourists and prospective settlers.

During the year 1925 over forty-seven thousand square miles were successfully mapped by means of aerial photography; and during 1926 an additional area of thirty-six thousand square

Department of National Defence

ALMOST A MAP

It would be very easy to make a map from this aerial picture of part of the Lake of the Woods. Try it. How many

miles was covered in the same manner. The first aerial map, issued especially for prospectors, was of the Pas district, in northern Manitoba. Maps of Red Lake and Rice Lake districts quickly followed, being in time for the "rush" that took place to those fields in the spring of 1926. The Carroll Lake sheet covered an area that had been previously mapped by the ordinary methods based on ground surveys; but the superiority of the aerial map was made clearly evident from the fact that it showed over three thousand lakes, and thousands of other topographical details, not recorded on the official chart.

The aerial photographs are taken at known elevations, with the focal axis of the camera pointing to the zenith, or at a fixed inclination to the vertical. The aeroplane travels in a straight line, and the exposures are made at regular intervals, so that no more overlapping occurs than is necessary to connect the survey. In Alberta during 1925 one plane photographed an area of 8600 square miles. In these photographs all physical features are shown in great detail, and the areas of forests, swamps, sandy wastes, the courses of streams and location of lakes are accurately delineated. The work in Alberta included maps of the district lying between Edmonton and Athabaska, a portion of the valley of the Saskatchewan River, to determine correlation of certain coal seams, and the aerial survey of the Buffalo Park at Wainwright.

In work connected with the prevention and control of forest fires, planes are employed with marked success. Ontario has an efficient provincial air service, which co-operates with the Royal Canadian Air Force in matters of common interest, such as topographical work. In Manitoba a forest area of fifty-three million acres is patrolled daily during the period of extreme fire hazard; and in case of fires, men and apparatus for fighting them are quickly conveyed to the spot. Similar patrols by the Royal Canadian Air Force are maintained in Alberta and British Columbia. In the latter province the Dominion Government owns the timber only in the strip of territory known as the railway belt: the service of the planes in patrolling other area is paid for out of the provincial treasury.

One of the regular duties of the Western arm of the Air

Canada Air Board

AN AIR VIEW OF WINNIPEG

Find the Parliament Buildings. What is the name of the river? Why is an aeroplane photograph so

Force is to keep a watchful eye over vessels coming from the Orient, in order to prevent the smuggling of narcotics or the illegal entry of Chinese. Incoming ships are met by planes, and kept under observation until they are docked. Several important seizures of narcotics have resulted from reports for Canada by these detectives of the air.

The Newfoundland sealing fleet in recent years have employed the services of an airman, whose duty it is to scout over the drifting ice-floes in search of the seal herds. Unfortunately for the seals, these airmen have been only too successful.

Aerial transport of mail, passengers and freight is already an accomplished fact. Before the construction of a railway into the Rouyn mining area of north-western Quebec, aeroplanes were regularly and successfully employed in the transport not only of passengers and mail, but of camp supplies of all kinds, including heavy equipment and machinery. Prospectors have been conveyed by air into districts practically inaccessible in any other way. The Post Office receives and delivers mail at the portal of the St. Lawrence, meeting the incoming and overtaking the outgoing ships. It is intended to carry on a winter mail service by air between Montreal and the open ports of Halifax and St. John. This marks the beginning of an aerial mail service that will extend from sea to sea across the continent.

The Royal Canadian Air Force included in its programme for 1927, in addition to the usual topographical surveys and fire-prevention work, the following useful services: (1) transportation of Government officials to pay treaty money to Indians living in remote parts; (2) patrol of Hudson Strait to ascertain the presence of ice; (3) the dusting of grain-fields in the Prairie Provinces to prevent wheat rust; (4) the dusting of insecticides over forests in Cape Breton Island to control the Spruce Budworm.

66. WIRELESS AND RADIO

It is needless to trace the early history of wireless telegraphy; but it is interesting to note that the British were the first to see the great potential uses of this system of communication. British scientists, like Sir Oliver Lodge and Lord Kelvin, prepared the way for Marconi's invention, which placed wireless telegraphy on a commercial basis. The British postal authorities adopted the idea as early as 1899, when Marconi's system was put in operation between England and France. By 1901 wireless communication was established across the Atlantic, and six years later, owing to the co-operative support given to the enterprise by Canada and Great Britain, the first transatlantic wireless telegraph was installed, with the terminal points at Cornwall and Newfoundland. When Lloyd's adopted the Marconi system its success was assured.

On this side of the Atlantic, Canada was the first to establish a system of radio-telegraph. Much difficulty had been experienced in maintaining submarine-cable connection with Newfoundland, owing to ice in the Strait of Belle Isle: so, in 1901, a system of radio-telegraphy was established between Château Bay on one side and Belle Isle on the other. The power for this station was obtained from dry batteries. At this time fifty miles was considered a long distance for the transmission of radio messages. But the great inventor, Marconi, made such improvements in his system that the range became indefinitely extended.

Since 1904 the passengers on the Cunard liners have been furnished with a daily bulletin of the latest news. By means of long-distance radio, transatlantic liners are now not only furnished with the latest news, but the passengers can keep in daily touch with either continent. The ships themselves are now kept informed, by means of the "aid to navigation" radio stations, of their chronometer ratings, the weather forecasts, and the location of icebergs.

The Canadian Government have instituted a "ship to shore" system of radio, comprising twenty-six stations and

six beacons on the Atlantic coast, and fourteen stations and one beacon on the Pacific coast. The Atlantic service gives direction to vessels as far as the head of navigation on the St. Lawrence and the Great Lakes. On the Pacific, the chain of stations extends from the Strait of Juan de Fuca to Alaska.

Some of these stations are so equipped as to supply ships with their position at sea, and are known as Direction-finding Stations. A ship within two hundred miles of the coast, and having a wireless installation, may get its bearings by calling up such a station, on a known wave-length. The Direction-finding Station transmits the true bearing of the ship from the station in degrees, all angles being read from left to right from true North; that is, from 0°, which is true North, to 359°, which is one degree West of true North. Bearings so ascertained are susceptible to errors, but under normal conditions they may be relied on within the limit of two degrees. The Government provides this service free of charge.

Some stations are equipped with radiophones only. They are chiefly used to locate ships in distress, and to give information as to their position to life-saving stations. They also supply to ships within their range the weather forecasts.

Radiophone service on our coasts is expanding very rapidly. Tug-boats and other coastwise craft are equipped with radiophone transmitters and receivers. Tug-boat companies are aware of the exact location of their tugs, and send them instructions as to their movements. Before the introduction of this system some tug-boat captains were inclined to "lay to" in the lee of an island for a longer period than was strictly necessary, especially when the fishing was good. Now they get a radio message to lift their hook and pull out.

There are many privately owned radio stations along the coast, installed at logging camps, mining camps, pulp-mills and canneries. These communicate with the nearest Government station, which will transmit any message received at commercial rates. In this way people in remote regions have direct communication with the outside world.

The Estevan station, on Vancouver Island, is so equipped as to hold communication with ships in any part of the Pacific

Ocean, messages having been exchanged with vessels at Hong-Kong, and at Wellington, New Zealand. In foggy weather the Government operates a wireless beacon on Race Rocks, at the entrance to the Strait of Juan de Fuca. Ships pick up the beacon by means of their own wireless or radio receivers, and are thus enabled to find their way through the strait.

On account of her vast area and scattered population, Canada derives a great benefit from the eighty-one broadcasting stations operated for commercial or publicity purposes throughout the country. Four hundred thousand receiving sets are supplied every day and night with a programme varying from market reports and university lectures through classical music, grand opera and jazz. People in the rural districts find the tedium of a lonely evening banished when they tune in on their favourite station. It means much, too, to the lonely dwellers of the far North, who, in the ordinary course of events, can hear from the outside world only once or twice a year.

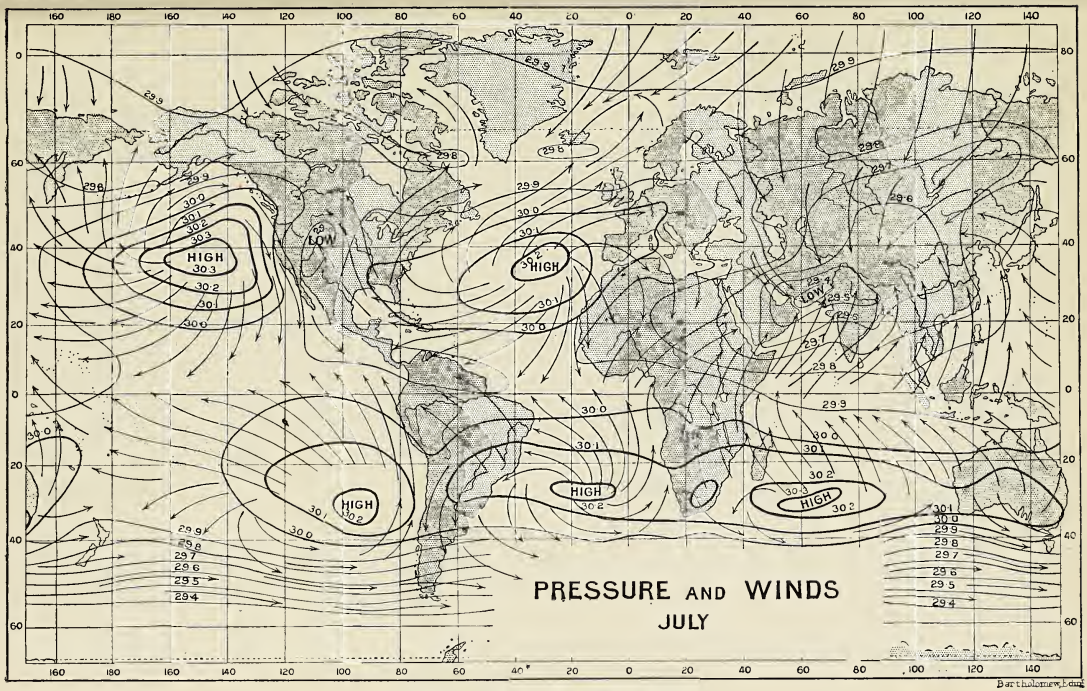
Man's use of radio-active force is only in its infancy. Already he is reaching out in search of energy that shall ultimately supplement or supplant the power he at present derives from coal. His reaching out into the infinite realms of space may finally put him into communication with the inhabitants of other worlds.

67. THE METEOROLOGICAL SERVICE OF CANADA

The Central Office of the Meteorological Service, popularly known as the "Weather Bureau," is situated in Toronto, Ontario, under the able supervision of Sir Frederic Stupart, Director, and Dr. J. Patterson, M.A., Assistant Director.

Reporting, there are some eight hundred stations, embracing the entire Dominion of Canada, from the Atlantic to the Pacific, and from the Arctic Circle to the International Boundary. Over half of these are voluntary observers, climatic data being obtained and forwarded without remuneration.

Weather Forecasts. — The work of the service embraces



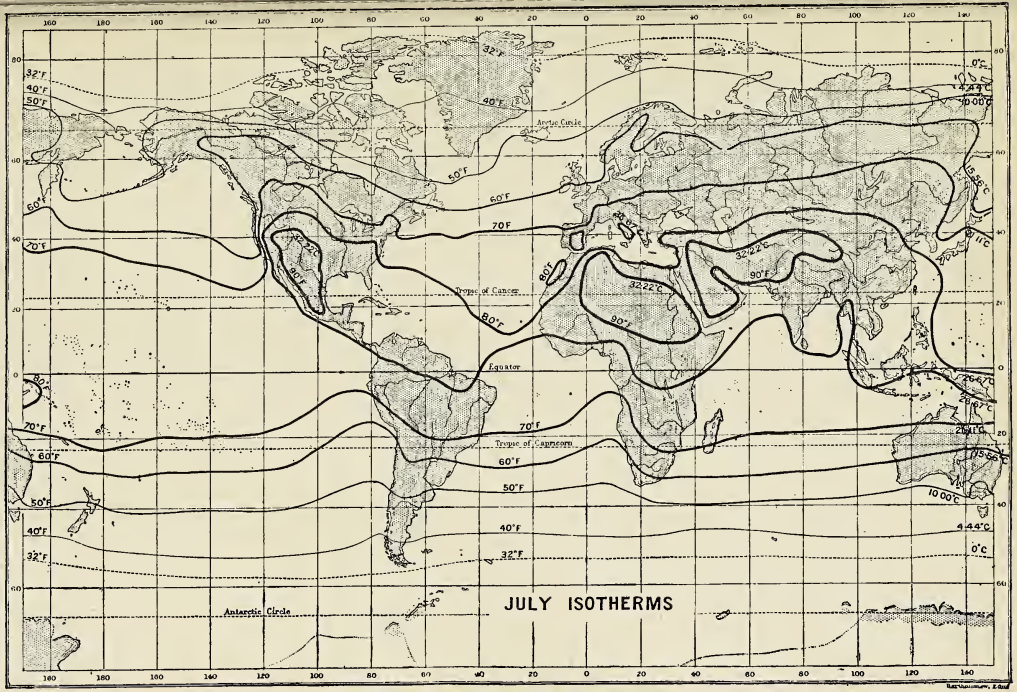
Bartholomew, Edinr.

MEAN PRESSURE AND WINDS FOR JULY

several departments, chief of which is the issuing of the daily weather forecasts. To make a forecast it is necessary to have information of what the prevailing weather is, over a broad expanse of territory, and for this purpose a limited number of observers telegraph their reports twice daily, at 8 a.m. and 8 p.m. Eastern Time, which is 5 a.m. and 5 p.m. Pacific Time. These reports are sent in code to the forecast stations, and are rapidly deciphered, the information being entered in figures and symbols on a large base map. This information includes the reading of the barometer, with the pressure reduced to sea-level; temperature; whether it is cloudy, clear or raining; the direction and force of the wind; and the amount of precipitation. The isobars, or lines of equal pressure, are found by connecting the points where the pressure is the same to the tenth of an inch. The isotherms, or lines of equal heat, are found in a similar way. When this is done, there are a number of curves in circular or oval form, indicating that storms operate in great eddies. Air flows from a region of high to a region of low pressure, just as water flows downhill, and the measure of difference in pressure is termed the barometric gradient, a steep gradient causing high winds, just as a steep slope causes a rapid flow of water.

The forecaster marks "High" where the pressure is highest, and "Low" at the point of lowest pressure. The regions marked "Low" on the map are usually centres of cloudiness and rainfall with the wind blowing spirally inward, and about the "High" there will be clearing weather, with the wind blowing spirally outward. Lows and Highs pass in an endless procession across Canada and the United States, causing the frequent weather changes. They follow well-defined tracks or routes, which vary according to the season, being more northerly in summer, and far to the south in winter. They usually enter the continent of North America from the North Pacific; hence the reports from the Pacific are of the utmost importance to the forecaster. They travel eastward at about the speed of an express train, passing off the Atlantic seaboard in about four or five days.

When the map is completed, it gives to the forecaster a picture of the prevailing weather conditions. He notes the



MEAN JULY ISOTHERMS FOR THE GLOBE

In the northern hemisphere the lands are warmer than the oceans.

storm centres, and their probable track, and estimates when the storms will arrive in the locality for which he is making a forecast. Within a very short time after the forecast is issued it has reached almost every interested person, either by telegraph, telephone, or the daily press.

Weather does not respect international boundaries, and the Canadian Service and the United States Weather Bureau exchange reports, as neither service could function properly alone. Their observations are taken at the same time, the same code embodying the same information. From a meteorological point of view no boundary lines exist.

Marine Reports. — Emanating from the turbulence of the North Pacific, the ocean storms make their initial entry along our western shores, so that the Pacific slope may well be termed the weather's "Main Entrance to the North American Continent." Prior to the advent of wireless, these storms came in with little or no warning, but now arrangements have been made whereby the ships become floating reporting stations, and send their reports in twice daily as far as the 180th meridian. This enables the weather map to be extended by plotting the ocean storm areas; and, whenever necessary, storm warnings are issued. The utmost importance is attached to each message received, and warnings have been ordered following the report of a single ship. It is one of the duties of the Weather Bureau officials at coast ports to check these observing ships' barometers, so that any error is known at the chief station.

Sea Temperatures. — For the purpose of investigating any change in the water temperature of the North Pacific which might affect our climate, thermographs have been installed on the vessels of the Canadian Pacific steamships plying between Vancouver and the Orient. The thermal element is inserted in the main intake pipe, and connected with a fine capillary tubing to the recording instrument, the charts being changed weekly, and the information plotted in five-degree squares. These instruments have a range of 50 degrees, from 35 to 85 degrees Fahrenheit, which covers the temperature range experienced in the North Pacific, except occasionally in the vicinity of Manila, where water temperatures over 85 degrees are recorded.

Forest Fire Protection.—It has been found that the danger from forest fires is greatest whenever the relative humidity is low; and, to give warning of this condition, a daily humidity forecast is prepared by the Gonzales Heights Observatory at Victoria, British Columbia. This information is broadcast to the lumber camps in the province, so that they may cease operating during the danger period, and is also available to the general public. Small-craft warnings for tugs are also broadcast, and are proving very valuable to tugs towing logs or scows.

Upper Air Investigation.—The advent of aerial navigation has rendered necessary the investigation of the upper air, and for this purpose three kinds of apparatus are employed: kites, sounding balloons and pilot balloons.

The kites used are of the box type, to which a self-recording instrument, called a meteorograph, is attached. As the line is paid out, the kite soon rises to a height where the weight of the line prevents it from rising; a second, and sometimes a third and fourth, are necessary for the purpose of lifting the line, until a height of from three to five miles is reached. The line is then hauled in, the meteorograph taken off, with its record of pressure, temperature and humidity.

A sounding balloon is made of thin rubber, is about six or eight feet in diameter, and is partially filled with hydrogen gas. Across the top, just before it is liberated, is thrown a silk parachute, to which the recording instrument is attached. The balloon rises until it finally bursts, the parachute, with the instrument, slowly dropping to earth.

The pilot balloon is about four to five feet in diameter, and is also inflated with hydrogen gas, but no instrument is carried, as it is used only for determining wind velocity and direction. An observation is made every minute, by observers using a special theodolite.

Seismology, etc.—Seismographs are installed at the Toronto and Victoria Observatories, and a record kept of earthquakes, as many as 318 being noted in one year. Instruments are also operated to record the earth temperatures at various depths, the amount of atmospheric dust in the air, and the solar radiation, for measuring the amount of heat received from the sun.

An important department of the service is the furnishing of correct time, this being supplied by telegraph, telephone, time-balls, and gun-fire.

Phenological records are kept of the influence of climate on animal and plant life, the time when leaves or flowers appear, the arrival of the insects or birds in spring, the maturing of fruit, and the departure of migratory birds and animals.

Weather insurance has become very popular, for protection of outdoor events, such as athletic meets of all kinds, pageants and fêtes, the weather records of the locality being called for to decide the loss.

Special reports are also sent out during the growing season, the grain market reacting to the slightest change in the weather. Weather information guides engineers and transportation companies in forming their plans. It is often required in the settlement of damage claims, and the production of records in court for legal purposes is sometimes necessary; in fact there is hardly a business, profession or occupation that is not influenced by the prospects of coming weather. The Meteorological Service is ever expanding and keeping pace with the demands made upon it by a rapidly growing and progressive country.

68. THE GREAT IMMIGRATION

The development of Canada has been linked with immigration. All the people in our country, except the Indians, have either come as immigrants, or are descended from those who had left their own land to seek a new home in Canada. And this great country, with less than ten million inhabitants, must depend upon immigration to provide enough people to develop its resources.

Many of our young native-born Canadians, who have the refuge of an established home, the benefits of Canadian schooling, and a certain knowledge of the land of their birth, face a real difficulty when they venture upon the enterprise of earning a living. But think of the thousands of immigrants who yearly

seek our shores, to meet new conditions and strange customs, with scarcely a dollar of our unfamiliar money between them and starvation! When William the Conqueror landed in England, he burned his ships behind him, and these people are in the same condition, for they have no money for the return passage to their native lands, but must become acclimatised, learn a new language, and adapt themselves to our ways.

But hope is in the heart of the immigrant,

> Who comes from far over the foam,
> To this land of his heart's desire,
> To rear his brood and to build his home,
> And to kindle his hearthstone fire.

The Great Immigration to Canada began in 1901, and from then, until the close of the war, 3,284,955 settlers have been admitted to our country, the peak year being 1913, with 402,432. Owing to the state of affairs in Europe, during and since the war few have emigrated, but with the present year the tide of settlers has again turned to our shores. There are three main classes of immigrants: those from the United Kingdom, whom we most prefer, but who are often poor and without experience in pioneer life; those from the United States, who have sold their farms, and have moved across the border to find cheaper land; and lastly, the Europeans and Asiatics, who are foreigners in the real sense. The peoples who have come since 1901 are largely the following:

British, 1,182,000; Americans, 1,255,154; Japanese, 12,457; Austrians, 200,016; Chinese, 33,036; Germans, 38,808; Russians, 97,171; Hindus, 5297; Jews, 75,976; Italians, 120,293.

How many immigrants are not included in the list above?

In good years over a thousand immigrants a day settled in Canada. Think of a town containing a thousand people being built between sunrise and sunset, with homes complete, with school, church, stores, streets and improvements. Imagine that to happen every day in the week, summer and winter! Or think of a hundred square miles of farms appearing in new places each day, and we gather some idea of the growth of Canada due to new settlers since 1900. Yet we need them all and more. In railroads and public service we are carrying the burdens for

a population five times as large as ours, and for years to come Canada will still be sparsely settled.

To induce these people to come to our country, the Government spent $18,000,000, or more than five dollars for each. Steamship companies were given $4·86 for each suitable settler they secured, and half that amount for children; advertising was carried on in the main centres of Europe, and agents in the United States received $3 per man, $2 per woman and $1 per child, on genuine settlers for Western Canada.

In the early rush of settlers anyone sober, sane and healthy, and not a criminal, was received in Canada, but, after 1918, the immigration laws were made more strict, and in the last few years 68,000 people have been turned back for lack of funds, as it is necessary for the settler to have $25 after he has reached his destination, unless employment is assured. The Government is also now more concerned about protecting the immigrant, while he is new to the country, from being cheated by those who would profit by his ignorance in a strange land.

The settlers we need are those who will work on the land and, if they do not speak English, will not settle in groups of their own, but will mix with English-speaking people, learn our ways, and become naturalised citizens. The law now requires that one must live in Canada five years, and have a knowledge of English or French, before he can become a Canadian citizen and have the right to vote. Less than half of our immigrants have become citizens. Let us visit among some of the different races of settlers to see how they are faring with us.

The British and American immigrants are hard to discover, because they are of our own race. The name British Columbia, the mountains and the sea have lured many British farther west. They have settled largely in cities and towns, where their business ability can be used. The Americans are successful wheat farmers on a large scale in the prairie section. They have added greatly to the prosperity of the country.

The Austrians have usually settled in colonies on the prairie. They came after the best homesteads were taken,

but they have cleared their bush farms, and are known as a thrifty and hard-working people. If the wheat crop fails, they depend on mixed farming, sheep, cattle, horses, butter, poultry and eggs. The women work sixteen hours a day, and clothe themselves on less than ten dollars a year. They milk the cows, tend the stock, care for the garden, pitch hay and stook wheat. If these people have no money, they do without even the necessities of life; they build their houses with sods, and thatch the roof with grass, use the ground as a floor, and wear sheepskin clothing when they have no fuel, and the little girls will wrap a cloth around a stick of wood for a doll, and seem just as happy as our children do with an abundance of toys. Many of these settlers left their homeland to escape military service, and have no desire to return.

The Italians have come in large numbers in the past few years, and are the most anxious of all foreigners to become naturalised. They have great difficulty in learning English, and drift in groups to the cities and towns. It is said that five families can live in a single room, one in each corner and one in the centre. The men do the hard rough work in building railroads and streets, where they work in a gang under an Irishman, who has command of certain words they seem to understand. These people also prosper in the candy stores, boot-black shops and greengrocery business.

The Orientals have largely settled on the Pacific coast, under protest from the people of British Columbia. The Japanese have gained great headway in the lumber and fishing industries, while their farming is generally limited to berry-growing. An understanding has been reached with the Japanese Government to the effect that only four hundred shall be admitted each year.

The great Chinese immigration has decreased since 1914 to about a thousand a year. In 1916, owing to lack of shipping space, only eighty-eight entered Canada. The Chinese pay a head tax of $500, and only three classes are allowed to enter: students, merchants, and the children of those who are already legally in the country. Many "students" and "merchants" have been found working in the sawmills and canneries. While one Japanese in four applies for citizenship, only one Chinaman

in ten asks for the same privilege, as the Chinese expect to return to live in China when they have saved enough money in Canada. Since 1900 over twenty thousand have left our country.

The Hindus arrived in British Columbia between 1905 and 1908. A Brahmin named Daviehand induced most of these people to come here, with the promise of work, in order that he might collect money from them. As the Hindus are British subjects, it was difficult to prevent them from entering Canada, but the law was changed, making it necessary for an immigrant to come direct from his native land, which was an impossibility for the Hindu.

In 1925 the British Government combined with the Canadian Government to put into effect an important colonisation scheme, by which three thousand British families should be established on Canadian farms. The British Government agreed to lend each family £300, for purchasing necessary stock, implements and furniture, while the Canadian Government undertook to sell them land at reasonable prices, with payments extending over twenty-five years. In two years 1500 families were settled under this scheme.

During the present season over a thousand immigrants a day are pouring into Canada. Most are English-speaking, although some are from Norway, Denmark and Holland, and all these people are very desirable. The railway companies are undertaking to find employment for these settlers, and many are able to buy land. Most are settling on the prairie, for they feel that they have a chance in a country where the average income of each man, woman and child for the past two years, from the sale of wheat, has been $300. The rate for immigrants from Europe to Halifax is only $10, to Regina $25, and to Vancouver $40. A special effort is being made to help English boys to become farmers in Canada. Our Government pays $80 each for the teaching of these boys in an agricultural college before they go on the land; for the hope of our new country is the young. The great future of Canada depends upon the children of to-day, the native-born, and those who have come from far countries at the call of the Great West.

MANY IMMIGRANTS ARRIVE IN NATIVE COSTUME

Of what race are these people? What kind of boots do the men wear? How do their garments differ from ours?

Department of Immigration and Colonisation, Ottawa

CHILDREN OF IMMIGRANTS

69. BANKING

In olden days, before a world-wide system of banking was inaugurated, trade and commerce were much hampered by cumbersome methods of exchange. A ship going to a foreign port for a cargo had to carry sufficient gold or silver currency to pay for the goods. The risk of loss by shipwreck, piracy or thieves was very great. The constant circulation of a metal medium of exchange resulted in the depreciation of the value of coins, owing to loss by attrition or by dishonest clipping. The system of issuing bank-notes, to represent the gold on deposit or in reserve, was much more convenient and economical, and helped to stimulate trade and industry; while the issuing of foreign bills of exchange simplified our commercial dealings with other lands.

The establishment of banks was a convenience to the ordinary citizen, whether engaged in trade or not. It provided him with a safe repository for his money, with the additional advantage of a small but assured return for its use by the bank; it encouraged thrift; and, when the privilege of issuing cheques was granted, it facilitated business transactions in many ways.

When the Dominion of Canada was formed, the British North America Act gave to the Federal Government exclusive control of currency and banking. This has done much towards making our banking system one of the best in the world. By the Dominion Bank Act, passed in 1871, the minimum capital of a chartered bank must be $500,000, and the shareholders are held responsible for a double liability; branches had to be established; bank-notes could not be issued for less denominations than $4; these notes were redeemable at any branch; the bank must hold Dominion notes to the extent of one-third of its reserve fund; no dividends should be paid to shareholders until an ample reserve was established. From time to time this Act has been amended to suit changing conditions, and to afford the public additional security in their holdings or deposits.

Though certain restrictions have been placed on the banks in regard to loans, generous exception has been made in case of the grain and cattle industries of the West. In general, the Canadian banks have played an important part in the industrial development of the country. The policy of establishing branches in small towns and rural communities has helped in an equitable distribution of capital available for loans.

In late years a process of amalgamation or consolidation of banks has resulted in a big reduction in overhead expenses connected with the operation of these institutions. At present there are eleven chartered banks in Canada, comprising nearly four thousand branches, of which about two hundred are located abroad. Bank deposits have more than doubled during the last thirteen years, and now amount to over two billion dollars.

Owing to strict Government supervision exercised by the department of the Inspector-General of Banks, instituted in 1924, the danger of bank failures has been practically removed. During the war bank-notes were made legal tender, but in 1926 the country returned to a gold standard, thus stabilising our currency and increasing the prestige of Canada in other lands.

The managers of banks have very grave responsibilities in the matter of lending money: responsibilities to themselves, their directors, the stockholders, the depositors, the business men of their city, and to the country as a whole. Much depends on their knowledge of local conditions, the probable trend of trade, the value of business securities, and their ability to read men. When a customer seeks accommodation at a bank, he sometimes discovers that character is more important than collateral.

When the bank lends money it asks for security from the borrower for the loan. It is usually thought that this pledge should be in the form of a title to property or the assignment of goods, but the best security for the borrowing of money is character. The manager of the bank looks upon the man who has carefully and regularly deposited even a little of his earnings in the savings bank, and who is honest in his business, as the one who is most worthy of receiving assistance and who will most likely make arrangements to pay back the money when it is due. If a boy starts a savings account when he is young he is building up credit for the future.

70. OUR NATIONAL PARKS

When the Dominion Government, acting on the advice of men disinterested in politics, but keenly alive to the best interests of their country, initiated the system of reserving or setting aside large areas to be maintained in the perfect state in which Nature had created them, they did not realise the potential value of these wild regions: they could not anticipate the attractive power these parks would have for the tourists of many lands, as well as for our own citizens. To-day these national playgrounds are the Mecca of thousands of world-weary pilgrims, who have become satiated with the mad turmoil of cities, and are seeking renewed health of body and vigour of mind by a brief return to the heart of unspoiled, unsullied Nature.

Ten thousand square miles of wilderness, chiefly in the region of the Rocky Mountains, have been set aside and dedicated in perpetuity to the conservation of wild life, to the preservation of unrivalled scenery in its primeval beauty, to the provision of opportunities for study and means of healthy recreation, not only for our own people, but for the strangers within our gates.

There can be no question that these wilderness reserves have already succeeded in staying the threatened extermination of many species of birds and animals. Antelope were perilously near the vanishing point; the elk or wapiti were doomed, as were also the mountain goat and bighorn sheep. Many wild-fowl, hunted ruthlessly in their fall and spring migrations, and deprived of their secluded nesting sites, were dwindling in numbers every year: the honking of wild geese and the trumpeting of swans were heard no more. But already, owing to the large areas in which they receive absolute protection, many familiar forms of wild life are on the increase.

Our national parks are unsurpassed in the grandeur, spaciousness and variety of their scenic beauty. The majestic sweep of the mountain-slopes, the white gloom of snowfields and glaciers,

the poise and serenity of the higher peaks, the massed and harmonious colouring of the flower-strewn meadows, and the solemn vastness of the forests, all combine to form an irresistible lure, to draw the feet of the unsatisfied to Nature's sanctuaries.

Our national parks are attracting many students who wish to make observations of our native flora and fauna in their natural habitat and environment. Being unmolested, even the most timid creatures, such as deer, wapiti, bighorn sheep, and bears, go about their daily business in utter disregard of the presence of man, and will pose for the amateur photographer with the studied indifference of the hardened globe-trotter. Let those who contend that Canada is lacking in wild-flowers go to the mountain meadows near the timber-line. Here, at the edge of the snowfields, they will find the flowers in abundance —masses of colour to delight the eye and tax the palette of the artist, or to fill with rare specimens the vasculum of the collector.

As the national parks of the Dominion are restricted to those provinces in which the Federal Government has control of the Crown lands, either in whole or in part, we find none of these reserves east of Manitoba, except the bird sanctuary at Point Pelee on Lake Erie and a small group of the Thousand Islands. However, this deficiency is partly offset by the generous provincial reserves that exist in most of the provinces. Even the provinces in which the Dominion Government has control have taken an active interest in the protection of game within the limits of the Federal forest reserves. Of the strictly provincial reserves the most notable and extensive are the Gaspereau and Laurentides National Parks in Quebec, and the Algonquin Park in Ontario. The total area set aside for park purposes by the Federal and Provincial Governments of Canada exceeds thirty thousand square miles. Within the boundaries of the national parks wild life receives absolute protection: within the provincial reserves, as a rule, a limited amount of hunting is allowed.

Of the Dominion parks the most important and extensive are located in or near the Rocky Mountains. The oldest and perhaps the best known to tourists from all parts of the world,

is the Rocky Mountain Park, established in 1887, and taking in an area of over twenty-seven hundred square miles. The well-known tourist resort of Banff is situated in this park, which has been in operation long enough to demonstrate the importance of such reserves in conserving our wild life, in offering recreational opportunities to our own people, and in revealing to the world at large the vastness of our natural resources. In motoring from Banff to Castle it is a common experience to run across a band of Rocky Mountain goats. Deer are met with everywhere within the boundaries of the park, roaming freely along the streets of Banff and filching dainties from the garbage cans. Nor is the increase of wild life restricted to the big game: fox, marten, mink, wolverine, grouse and partridge abound. On Cuthead Mountain, Massive, and the Three Sisters, bighorn sheep have increased almost to the limit of their food supply. Nature takes care of overcrowding, however, and the surplus wild folk are helping to repeople the forests and hills outside the boundaries of the reserve.

The largest of the Dominion reserves is Jasper Park, established in 1907, and comprising an area of 4400 square miles. Within its confines are over a score of mighty peaks, including the "Queen of the Athabaska," Mount Edith Cavell. As a game preserve it is bound to prove of inestimable value, as within it are natural range for moose, wapiti and caribou. Thousands of tourists visit the park every year, attracted not only by its scenic beauty and the glimpses of wild life it affords, but also by such conventional allurements as golf, one of the finest eighteen-hole courses in the world being located in the vicinity of Jasper Park Lodge, a tourist hotel operated by the Canadian National Railway.

In the south-western corner of Alberta is situated the Waterton Lakes Park, which adjoins the Glacier National Park, across the boundary. The two parks in conjunction form one of the most important wild-life reservations on the continent. It abounds in all forms of animal and bird life indigenous to the northern Cordilleran region.

For the special protection of the pronghorn or antelope, an area of about five thousand acres in southern Alberta has

been fenced off from the surrounding prairie. This graceful, swift-footed animal at one time occupied the same range as the buffalo, wandering in small herds, which collectively contained millions of these unique creatures. But they melted away before the white man as did the buffalo; though, unlike the latter, they could not be bred in captivity, and, in consequence were doomed to extinction. The small herd enclosed at Foremost, Alberta, has nearly trebled in numbers, and hopes are entertained that the species may be saved.

A BUFFALO *Wainwright Buffalo Park*

The Buffalo Park at Wainwright, Alberta, contains about one hundred and sixty square miles, enclosed by a special wire fence seventy-six miles long. The original herd, consisting of about seven hundred head, has increased to such an extent that there is not pasture enough for them: so the Government have transferred several thousand of them to Wood Buffalo Park, near Fort Smith in the North-West Territories.

Elk Island Park, as the name implies, was a reserve set aside for the protection of the elk or wapiti: but other animals have not been slow in making use of it. Moose, mule deer and buffalo are increasing within its boundaries.

Other national reserves, set aside chiefly for their scenic attractions, but incidentally forming much-needed game preserves, are the Yoho and Glacier National Parks. The former contains some of the most beautiful mountain scenery in the world, which will soon be made accessible to the motorist by way of the Kicking Horse Trail.

71. HUNTING AND FISHING

CANADA has the privilege and responsibility of giving shelter, sustenance and protection to many forms of wild life that have practically disappeared from other parts of the continent. Many of these forms once peopled the forests and plains to the south of us in such incredible numbers that they seemed inexhaustible. But they have disappeared; some species that were at one time most numerous being almost or quite extinct. The geographical position and physiographic features of Canada, which delayed settlement of our wild lands, also delayed the destruction of our wild life. In the meantime, an object lesson had been given to us in regard to the importance of conserving our natural resources, including our native birds and animals. Wise laws regulating hunting and fishing were enacted, a system of national parks for the conservation of wild life was instituted, and the public consciousness was aroused. Practically the whole of Canada became a game sanctuary.

In spite of this fostering care, or rather because of it, Canada is regarded by the sportsmen of many lands as a hunter's paradise; and the angler can obtain good sport in any province of the Dominion. Her vast forests, lakes and streams; her mountains and plains; her great extent of coastline and range of climate—all contribute to make our country an ideal home for all forms of life indigenous to boreal America.

In Prince Edward Island, known as the "Garden of the Gulf," we need not expect to find any big game; but for the hunting of wild-fowl, such as geese, brant and ducks, of shore-

birds, like the snipe, and of upland birds, including woodcock and plover, the districts about Tignish and Souris offer special attractions to sportsmen whose health does not permit of "roughing it" in a wild region.

For a province of such small area and so long settled, Nova Scotia has a variety and abundance of game that is truly remarkable. Caribou are given immunity until 1930, but there is an open season for moose, deer and bear, whose range can

Department of the Interior

A TROPHY OF THE HUNT

What animal have they shot? In what province do you think they might be? Why? You will see that most sporting pictures show woods and waterways. Turn to the chapter on Canada's Wooden Walls, and see if you can find an explanation.

be reached without undue hardship. Geese, brant, ducks and shore-birds abound. The shooting of woodcock and ruffled grouse is permitted during a short season; but absolute protection is afforded the spruce partridge, sharp-tailed grouse and wood-duck. Excellent fly-fishing attracts many anglers to the inland waters of Nova Scotia; while tuna-fishing with rod and line, and the harpooning of swordfish, offer exciting sport to those who spend their holiday on the sea-coast.

Immortalised by the classic stories of C. G. D. Roberts are the hunting-grounds of New Brunswick. Though the wild interior of the province seems a virgin wilderness, unmapped

and untrammelled, it is none the less carefully intersected with survey lines, that are used by the experienced guides in directing the hunting operations of their respective parties. In this way no two parties hunt over the same ground, which helps to conserve the game, and to give each sportsman a chance to bag his moose. One bull moose and two deer are

Department of the Interior

A DAY'S BAG

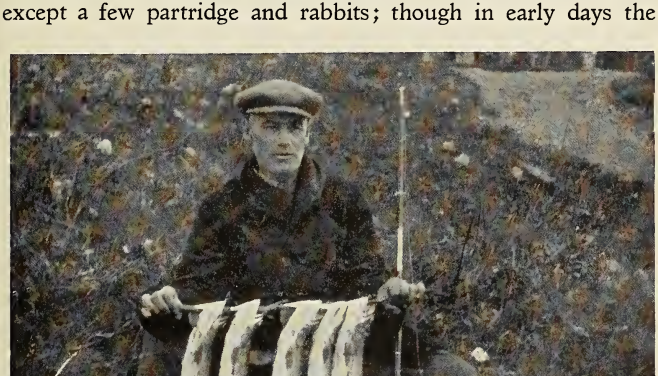
Notice the dogs at the bottom of the picture. What has been their share in the day's sport?

all that the law allows, and all that any true sportsman should desire.

Quebec, the oldest province in Canada, so far as actual settlement is concerned, covers a terrain so vast and so diversified that almost every species of game indigenous to the great Northland finds here its natural habitat, unspoiled by the hand of man. From the borders of Vermont, to the region of perpetual ice in far Ungava, the sportsman finds unbroken forests or wide barrens, where he may live the life of primitive man, face to face with Nature, knowing that she will reward him with the richest of her gifts, peace of mind, a good appetite

and wherewithal to satisfy it. It is unnecessary to enumerate the game that is found in Quebec: with the exception of mountain goat and bighorn sheep, she has all the legitimate game that is found in Canada.

Ontario is very similar to Quebec in regard to her hunting attractions. Very little game exists in Old Ontario to-day, except a few partridge and rabbits; though in early days the



Department of the Interior

"THE COMPLETE ANGLER"

Notice the reel on the fishing-rod. What is its use?

province abounded in game of all kinds, including wild turkeys. In northern Ontario, however, deer, moose and caribou are found, along with the ubiquitous bear. But in south-western Ontario is situated Jack Miner's bird sanctuary, and the Pelee Island reserve for migratory wild-fowl, oases of rest and refreshment in the desert of destruction that stretches from the Gulf of Mexico to Hudson Bay.

The Prairie Provinces, with the exception of western Alberta, are very similar as regards their faunal life. It is useless now to enlarge upon the former glories of this region as a hunting-ground. The buffalo and antelope are gone, never to

return. In the wooded belt, through which the sixtieth parallel passes, are found prairie chicken, grouse, deer, moose and caribou; while on the innumerable lakes and sloughs legions of wild-fowl congregate during the spring and fall migrations. The hunter must exercise strict control over his trigger-finger, or he will exceed the generous bag limit allowed by the game laws of these provinces.

The faunal character of western Alberta is similar to that of British Columbia. Mountain goat, bighorn sheep, mule deer, wapiti and grizzly bear, besides moose and caribou, offer the hunter unexcelled opportunities for sport in almost every section from the forty-ninth parallel to the Yukon. The numerous narrow lakes and snow-fed rivers are well stocked with trout; but salmon, though they ascend these streams to spawn, cannot be persuaded to take any kind of bait after they leave the salt water.

Hunting in Canada and the United States has passed through various phases, which are intimately connected with the growth of civilisation in the New World. In pioneer times every man was a hunter. He hunted as the Indian did for food and clothing. Clad in buckskin of his own tanning and tailoring, and armed with a muzzle-loading, single-shot musket or rifle, he sallied forth in search of meat for himself and his family. Fortunately he did not have far to go: deer were everywhere. As for the birds, whether wild turkeys, partridge, ducks or geese, he left such insignificant creatures to the boys, who practised on them with their bows and arrows.

The hunting era passed away with the quickly vanishing forests. As game became scarce the settler seldom went out after deer or bear, except to eke out the contents of the pork-barrel. The growth of towns and cities gave rise to the pot-hunter, who devised schemes of slaughtering game wholesale to supply the market. The demand for game increased as the supply diminished, and the pot-hunters put up their prices, until partridges were selling at $2 each on the New York market. Meantime a new line of sportsmen had come into prominence: those who hunted for recreation and to come into healthy contact with Nature. These men, becoming

alarmed at the rapid disappearance of game, gave their hearty support to scientists and statesmen, who for some time had been trying to check the destruction of our wild life. The passing of the pot-hunter did not come soon enough to save the passenger pigeon, the Labrador duck, and several other species, from extinction; but with rigid enforcement of the present laws, and earnest co-operation on the part of the people, most species of game, whether birds, animals or fish, may recuperate to the extent of affording legitimate sport to future generations.

72. THE TOURIST TRADE

THE natural diffidence of the Canadian people has made them slow to appreciate the marvellous attractions of their vast and diversified Dominion. They have grown to love in an undemonstrative way, not only the spectacular glories of their native land, but in a still greater measure its homeliness and subtle lure, inseparable from the unfailing miracle of spring, the lush fields in June, the leagues of yellowing grain, the dreamy haze of autumn, and the enchantment of the snows. But they are only just beginning to realise that the world at large, weary of the over-culture of cities, is seeking relief and brief forgetfulness by getting back to simpler and more natural environments, and that Canada presents to such travellers an infinite variety of attractions.

In the early days, the tourist was drawn to our borders by the thunder of Niagara and the Whirlpool Rapids below; he might cruise through the Thousand Islands, navigate the Lachine Rapids, and admire the beauty of the Laurentides as he leisurely voyaged down the mightiest of Canadian rivers. If he were a sportsman, he might be tempted to follow a guide into the mazes of a New Brunswick forest in search of moose, or to make a trip up the Restigouche after salmon. But of the vast interior of our country he had no conception, nor had he any facilities for discovering its varied charms.

The construction of the Canadian Pacific Railway across Canada opened entirely new territory to the tourist. The boat trip from Owen Sound to Port Arthur satisfied the less adventurous at first; others were drawn to the unbroken prairies of Athabaska and Saskatchewan, where the wild-flowers rivalled the sunsets in the splendour of their colours; or they pushed on to the foothills of Alberta and obtained an unforgettable first glimpse of the Rockies. The establishment of Banff in the Rocky Mountain Park, the first of a series of national reserves, did much to make Canada known to the tourists of the world.

A second transcontinental line, the Canadian National, struck through the heart of the great Northland, and crossed the Rockies where their scenic grandeur culminated in a panorama of majestic peaks. Meantime, however, a more potent factor than railways in the promotion of tourist traffic had been set in operation. The coming of the automobile into general use marks the beginning of a new era in the history of travel. From the observation car of a transcontinental express men had caught fleeting glimpses of reeling peaks and foaming torrents: but these moving-pictures, though leaving only a blurred image on the memory, left an impelling desire in the heart, a yearning to live for a brief time in the midst of these glorious surroundings. The advent of the automobile led to the building of roads and highways into this land of dreams, and the tourist has been granted his heart's desire. He can now motor at ease and in comfort into regions that a few years ago were inaccessible except to men, such as prospectors and trappers, who are inured to a life of hardship, privation and danger.

Now, instead of lodging at crowded hotels, and being whisked off at forty miles an hour through a blurred landscape, the tourist may loiter at will where the scenery is attractive, or speed up through uninteresting country, to draw up at nightfall where some wayside camp site offers solitude or companionship, according to his mood. If he is fastidious and does not care to rough it, there are, in the heart of the wilderness, first-class hotels, which he may use as base camps for his explorations.

Tourist traffic in Canada is not confined to mountain areas

or to one or two provinces. Every road that crosses the international boundary, from New Brunswick to British Columbia, from Maine to Washington, is pouring its quota of cars into Canada. Nor must it be forgotten that, in a less degree, corresponding to our smaller population, there is a string of cars headed the other way, setting up a reciprocity in sightseeing that is uncontrolled by any treaty.

One of the best results of the great influx of tourists has been the building of new highways, and the improvement of the old, in every province of the Dominion. Quebec has taken the lead in the building of new roads of good construction. In ten years she spent over thirty-eight million dollars in this work. The Dominion Government has generously assisted the provinces in highway construction by voting $20,000,000, divided on the basis of population. Most of this money has been spent in opening up a system of inter-provincial highways, which will ultimately reach from the Atlantic to the Pacific, and have a total length of 25,000 miles.

But we must have something more than good roads to attract tourists. Our greatest recreational asset at the present time is the part of our country that man has left untouched by his despoiling hand. Our forests, lakes and rivers, with the wild life that they foster, are the magnets that draw hundreds of thousands of tourists across the line and from overseas. If the traveller wishes to see examples of man's creative handiwork, he will seek for it in the Old World, not the New. It is the desire to get away from skyscrapers and all they stand for that takes him into our unspoiled wilderness.

73. HOW CANADA CARES FOR HER INDIANS

THE Indian of to-day, as he drives his load of wheat to an elevator in Alberta, or rows his catch of salmon to a cannery on the Skeena River, may not be as romantic a figure as his ancestors, who hunted the buffalo on the plains or trod the forest with tomahawks in their hands, but in habits and thought he is still the simple child of Nature.

How does the Indian live without his land and hunting-ground? No longer free to wander at will, is his race doomed to extinction? Is he contented with the ways of civilisation, and better cared for by the Canadian Government than when he roamed at large and hunted with bow and arrow?

One may travel from coast to coast and scarcely see an Indian, yet there are over a hundred and ten thousand in Canada, and the number is on the increase.

As a child, I had never seen an Indian until one evening, as I went to fetch the cows, a smoke arose from the group of alders at the far end of the pasture, which sloped down to a little stream that flowed into the Atlantic. To my surprise, I found in an open space in the grove a tent made of birch-bark, and an Indian, his wife and papoose squatted round the fire. Next day, after school, when all the pupils hurried to the spot, there were at least a dozen families in tents. Every day we visited them, and stood watching their strange manners. The Indians cut and peeled young willows, and from the wands the squaws wove beautiful baskets, which were sold at the store in the village. Their housekeeping was simplicity itself. They bought fifty loaves of bread at a time, sliced and buttered it all, tossed it into large clothes-baskets, and left it outside to the tender mercies of the hot sun and the flies, until it was all eaten. One day they were with us in full force, and the next evening they were gone, with only the charred remains of many fires and a broken paddle to remind us of our recent visitors.

Years later I saw my first Western Indian on the station

Department of Trade and Commerce

INTERIOR OF SKEENA RIVER CANNERY

platform at Moose Jaw. As we descended from the train, we noticed his straight figure wrapped in a blanket. A young passenger, making his first trip west, approached the Indian for closer observation. The native, with a quiet gesture, handed him a five-dollar bill, and asked him to purchase a bottle from the hotel across the street and to keep the three dollars change. It seemed an easy way to earn the money, but as he handed the Indian his bottle, a policeman tapped him on the shoulder, and led him away. Instead of continuing his journey, the young man became the guest of the Mounted Police. There is a fine of $300 and a penalty of six months' imprisonment for selling liquor to an Indian. Later still, I often visited a friend, who taught in the Industrial School at Battleford, where I had a chance to observe the effect of education on the younger generation.

The British Government always recognised the Indians' claims to the lands of Canada, and between 1763 and 1860 bought large tracts for cash from the Indian tribes of Eastern Canada, although in most cases the purchase price was only a few cents an acre. After 1867 the Canadian Government undertook the management of the Indians. Their policy from the first was to treat with the Indians for their remaining lands, and then to settle them on reserves and care for their needs.

The problem was a serious one in the West. Lord Selkirk, when he bought, in 1811, over a hundred thousand square miles from the Hudson Bay Company for his Scotch settlers, found that he had no right to the land, because it really belonged to the Indians, who were well aware of their title. So he treated with them for both sides of the Red River and the Assiniboine, at a distance from their banks as far as one could see daylight under a horse.

The purchase price was a hundred pounds of good tobacco a year.

When the new settlers were harassed by the fur-traders, and were unable to wrest a living from the soil, they journeyed south several winters to Pembina, where they worked for the Indians in return for food and shelter.

In the treaties the Indians have surrendered their lands to the Canadian Government in return for certain considerations:

1. Yearly treaty money of $5 for every man, woman and child, $20 for each chief, and $10 for each headman.
2. The Indian reservation to comprise one square mile for each family of five.
3. Free medical care.
4. Blankets and food to be provided for the aged and infirm, as well as a weekly ration of five pounds of flour, seven pounds of meat, and one pound of tea monthly for all in need.

The words with which a chief concluded a treaty are memorable: "Now you see me stand before you all; what has been done here to-day has been done openly before the Great Spirit, and before the Nation, and I hope I may never hear anyone say that this treaty has been done secretly, and now in closing, I take off my glove, and in giving you my hand, I deliver over my birthright and lands; and, in taking your hand, I hold fast all the promises you have made, and I hope they will last as long as the sun rises and the water flows."

In 1879 a great calamity overtook the Indians. An extensive prairie-fire swept the country from the Wood Mountains to the Rockies. The buffaloes, which had been slaughtered by both Indians and Whites for their hides, failed on this fateful year to cross the barren stretch and journey north. The great yearly buffalo-hunt was a thing of the past, and dire want stared the Indians in the face. The Government did its best without a railroad to supply beef and flour at the different posts, but there was much suffering. Since those lean years, when all the Indians had to be fed, the Government has now arranged that there has been a lessening of the rations, until now in no band are all the members fed free.

This has been accomplished by teaching the Indians how to farm, and by selling part of the reservations, as the land has become more valuable. The purchase price has been used to care for the Indians. On June 18, 1910, 115,000 acres of the Blackfoot Reserve in southern Alberta were sold at $14 an acre. Fifty thousand dollars of this sum was set aside for

workhouses and farm machinery. The sum of $350,000 was to be expended in the next five years on the reserves in building 160 cottages, boring wells, making roads, fences, and general repairs. The interest from the rest of the fund was to be used for supplying the weekly rations mentioned above.

In British Columbia the sale of Indian lands is managed by the Provincial and Dominion Governments together, because this province, before confederation, had made treaties with the Indians differing greatly from those in the rest of Canada. The Indians at the coast are quite capable of making a living. They are good fishermen, expert basket-makers, and they also work in the hop-fields and in the canneries. On the northern coast they are the only people allowed to hunt the seals, which in early spring go north in great herds, but they must use dugouts for boats, and kill with the spear.

Indian schools are usually under church control, and receive a grant from the Dominion Government. Industrial schools were organised with the hope of teaching the young pupils to learn trades, but the Indians are not mechanical, and have little desire for steady work. Now these schools teach the regular courses and give some training to the boys in farm-work, while the girls are taught sewing, cooking and general housework. At first a large percentage of the pupils died of tuberculosis, but more carefully designed buildings have resulted in better health conditions.

An Indian pupil is hard to teach. He or she rarely answers a question, and certainly never asks one. The most amusing situations never provoke a smile. Of what is the little Indian thinking when he looks straight ahead in school? Perhaps he pictures the mossy logs and murmuring streams of the deep and solemn forest, through which he glides with bow and arrow.

When the treaty money is to be paid, the Indians arrive in town several days ahead of the agent, and usually owe the store the full treaty money before it is paid. The Indian agent has to be careful that he does not pay the treaty money twice, as small children are sometimes borrowed by another family to increase the yearly revenue. In the Northland the treaty

money in certain districts is carried by aeroplane. The doctor accompanies the agent, and, if necessary, vaccinates the Indians as they are paid. At one village all the Indians were hidden, because the priest had told them that the Angel of Wrath would visit them from the sky because of their sins. Never having seen an airship before, they thought it a proof that the priest was a true prophet.

When an Indian has proved to the Government that he can take care of himself and his family, he is allowed to become a citizen of the country, and may vote at the Dominion elections and at the Provincial elections in Eastern Canada. The Indians are learning to grow wheat and to take care of stock, while in twenty-five years their wealth has increased a hundredfold. When a chief is greatly dissatisfied, he takes a trip to London to see the Great White Father, the King. While we are anxious for the Indians to learn our ways, and to become useful factors in our civilisation, we should never forget that these children of Nature possess many noble qualities which we would do well to consider.

74. SIX THINGS THAT EVERY BOY AND GIRL SHOULD KNOW HOW TO DO

1. *First Aid.*—In case of an accident, every boy and girl should have sufficient presence of mind to render first aid to the injured without creating a panic, and then to summon help. When children are playing together injuries are common, and sometimes a knowledge of first aid may save a life. One should know whether an artery or a vein is cut, and how to bandage for bleeding, the names of three or four antiseptics and why they are used, how to treat a sprain, what to do for fainting, how to bathe a bruise and treat a frost-bite, and what to do to recover a victim from drowning. A Boy Scout or a Girl Guide is taught first aid in a practical way, and one should join such an organisation for this and other beneficial training.

2. *Cooking.*—Every boy and girl should know how to do

I

II

III

From "The Way to Health"

STEPS IN THE PROCESS OF ARTIFICIAL RESPIRATION

simple cooking, and while it is taken for granted that every girl is a potential cook, the number of dishes that an average girl could prepare and serve would be probably surprisingly few. A boy will find a knowledge of simple cooking most practical. How a man can eat dishes of food for a lifetime, and never wonder how they are prepared or exactly what they contain, is a mystery. A boy who can prepare a meal is often of the greatest assistance to his mother, while many a bachelor in the West has constantly grieved over the fact that he never learned at home something of the art of cooking. A man who leaves early for work should be able to prepare his own breakfast, and in camping or in times of sickness in the home the ability to cook a meal is of real importance. The way for a boy to learn is to obtain permission at home to prepare a meal, and, from the comments passed while it is being eaten, he learns how it should be done. The dread of washing dishes is one of the innate fears of the human race, and the most popular member of a family is the one who undertakes this task willingly. The washing of the dishes completes the work of serving the meal, yet the climax seems to be reached when the food is eaten, and enthusiasm wanes at the sight of the disordered board. When we think of the beautiful glazed surface of porcelain and china, and how easily it responds to soap, hot water and clean towels, and then imagine the cleaning of wooden dishes of an earlier age, dish-washing, especially if done promptly, should lose all of its horrors.

3. *Sewing.*—Every boy and girl should know how to sew. Of course every girl does, but few boys seem to master the art. To watch a man thread a needle borders on the painful, and it is only in desperation that he ever attempts the task. Yet practice is all that is necessary, as one may vouch from watching a tailor. If a boy learns how to sew on buttons, darn holes in stockings, and mend a rent, he will find many opportunities to use his knowledge and relieve his mother. As a young man, earning his living away from home, such simple sewing will save him money, and sometimes great anxiety.

4. Every boy and girl should not only know how, but be willing, to wash and iron clothes. The art of laundering different

textiles is far more complicated than a novice would imagine, necessitating a knowledge of the effects of soap, colour running, and shrinking. Many a woman does the family washing, when such laborious work might well call for the assistance of the husband or sons. Washing clothes is easy work for a man or boy, but a tiresome task for an overworked mother; and often in the country, where laundry-tubs are seldom used, the carrying and emptying of the water is beyond a woman's strength. If a boy, proud of his strength, would always consider how he could help his mother with her arduous duties, he would have greater peace of mind after she is laid to rest.

5. Every boy and girl should know how to use such common tools as a hammer, saw, screwdriver and wrench. It is surprising to find the number of city men who have to send for a carpenter or plumber to make some easy repairs in a house. Every home should have a simple set of tools, with a place of their own in which they are to be found, so that one does not have to depend upon borrowing from a neighbour in an emergency. A little practice with these would allow a woman to fix many things in a home that, not attended to at the time, are forgotten until serious damage is done. It is also important that a woman know how to sharpen a knife or a pair of scissors, as for want of this knowledge she is often handicapped in her work.

6. *Gardening.*—Boys and girls should possess in common a knowledge of gardening, and should know the names and seasons of the flowers that we all love, and how they are best grown. To grow vegetables from seeds that they have raised is to give boys and girls a share in the glory of summer, and a sense of their partnership with Nature.

75. CHOOSING AN OCCUPATION

One of the most important decisions that each of us has to make is choosing an occupation, and this difficult task comes when one has not travelled far on the wonderful journey of life. To youth the world seems full of boundless possibilities, and it is, if we but have the wisdom to grasp them. There are

two main ways of securing an occupation. One that is followed by far too many boys and girls is to wait until employment must be secured, and then to take the first situation that opens, only to find it, after a time, uncongenial or unremunerative. Then, with difficulty, they enter another field, for which, like the first, they have no special aptitude or qualifications, and so become drifters. The other and better way is to select work for which one has an inclination and some preparation, and in which older people conversant with its possibilities feel that one has a prospect of success.

In the early pioneer days in Canada, the people all wrested a living from the soil, but in order to be comfortable they had to be skilful in many other kinds of work besides farming. They built their rude homes, made their own furniture and clothing, and nursed their sick. Almost from the first certain persons were discovered in each community who excelled in particular arts. One woman would have a skill in the mystery of medicine, possessing the gift of brewing concoctions from field-herbs, terrible to the palate but effective in sickness. She would be the Florence Nightingale of the district, and would pass many a lonely vigil at the bedside of the sick. Some other woman would be expert with scissors and needle, and dress material would be brought to her for cutting and fitting, while another would be "ayot" to the community, and all the other women would implore her to divulge how she managed such effects in biscuits, doughnuts and fruit-cake. There was always a farmer in the settlement who knew more than the others about building, and who would superintend the planning, framing and raising of the timbers for a barn. There was ever one man who cared little for farming, but excelled in the repairing of all contrivances from a watch to a wagon-wheel. When a neighbour's clock was out of order, he would boil the works, and put the timepiece together in working order, with several wheels left over. He also extracted teeth with great pain and little ceremony, charging the same price of 25 cents, whether he drew the right one or a wrong one.

But times have changed with the years; we live to-day in an age of specialists, when a person does one kind of work

only, and through constant practice becomes a craftsman. Our pioneer forefathers, who prided themselves on the variety of their efforts, though they are scarcely remembered in story, have bequeathed to us a facility for doing many different kinds of work, and this inheritance makes it easy for the Canadian to adapt himself to a second occupation should the first one fail.

The first thought in the mind of a youth considering a vocation is usually whether it means hard work. He sees a labourer on the street during a July day wielding a pickaxe, and then looks through the window at a bank teller counting money, and he thinks he knows which employment he would rather follow; but nuggets of gold have been found where the pickaxe has dug, while the bank clerk may spend many worrisome evenings in finding where a stray cent has kept his ledger from balancing. With shortened hours, and an increased scale of wages to meet the demands of a higher standard of living, the toilers of the world are toiling less and less. The people of all classes are learning more and more how to play, and are absorbed in sports, while those who believe that work is good for others, but lowering to their own social standing, are numerous to-day, even as in feudal times. But work is the salvation of mankind, lending us dignity and nobility. Through the exercise of muscle and brain we develop ourselves and compel Nature to supply our needs. Happy is the man who finds pleasure in his work, and he who through toil feels the glory of achievement needs not to envy kings and princes. Let no boy or girl bemoan the fact that he or she is not born with marked ability, for successful people are often rather persevering than clever. This is the great promise that makes life glorious, that our mark in life is not determined by our intelligence quotient, a matter of inheritance, but by our determination to do to our utmost the duty that lies nearest us. By industry cities have risen where forests have been, the world of people is clothed and fed, and each receives in just measure according as he has performed in honest effort. Seek an occupation that demands work, and by persevering you will find room at the top opened to you by those who sit down to rest.

The second thought that naturally rises in the mind of the youthful aspirant for a vocation is concerning the remuneration it offers. An idea shared in common by our generation is that a large amount of wealth is necessary to enjoy ourselves properly; but the best things in life money cannot buy—health, without which all beside is futile, the beauty of the sunset, the sacredness of friendship, the love of family and the glory of service. Simple habits and the saving habit make a small wage look big. It is not what we earn but what we save that counts. Dollars have as many different values as the number of people through whose hands they pass. If you do your task better than others, you will command a wage according to your work. Those who work for the work alone always receive sufficient pay, while those who work for the pay alone never receive enough.

Parents, in planning for the future of their children, usually consider four requirements that a vocation should guarantee: health, safety, advancement and social position. It is unfortunate that all labour cannot be performed in the open air, for health is the greatest blessing in life, and must always receive first consideration. Working where acid fumes are liberated, or using grinding and polishing machinery where sand and metal dust are inhaled, may shorten one's life by twenty years. Surely it is wise to avoid such labour. There is always a great danger in working with explosives, and in tunnelling and mining, but constant watchfulness overcomes a large part of the risk in such employment. The public press always features death by accident, and by reading thoughtfully such accounts one learns to avoid danger. Generally a vocation which offers advancement starts the beginners with a small remuneration, and rewards perseverance. The future of different industries varies greatly, according as to whether they are basic, and therefore enduring, as agriculture, mining of staple products, or whether they are specialties, and have already outlived their demand. It would not pay to engage in the manufacture of wagon-buggies or sailing-vessels. In our democratic country the social value of a vocation is negligible. The tendency is to lessen class distinctions based upon occupations. It is what we are, not what we do, that determines our social merit. Spirit

calls to spirit, and kindred worth seeks her own across the barriers of daily environment.

When the young voyager plots his course on the adventurous sea of life, and examines his chart for the ways marked *easy* and *lucrative*, and his parents look over his shoulder to point out the passages of *health*, *safety*, *advancement* and *social standing*, let the mentor of life, ripe with the experience of ages, and young with the hopes of the future, speak and advise youth to nail to the masthead the pennant of *service*. Whether one sweeps the streets, teaches the young, or grows bread for the hungry, his occupation is created, not that he shall live, but because his is a needful work for mankind in general. Public service is the real measure of one's vocation.

76. EMPLOYMENT FOR GIRLS

The Clerk. — Every year an increasing number of young women undertake to earn their own living, and seek employment in the industrial world as clerks in stores, factory and laundry workers, office girls, stenographers and telephone-operators, or in the professional world as nurses and teachers. A position that demands no special preparation, and is easy to secure, is that of sales-girl in a store. For the girl who only considers her work as the means of earning her weekly salary, the scale of wages is limited indeed; but for the one who really desires to learn the business, and becomes as interested in it as though she were the owner, the chances are that she will some day conduct a business of her own, and become a factor in the industrial world, where the possibilities are unlimited.

To be successful in the art of selling, one must know thoroughly the goods to be sold, how they are made, all their properties and uses, wherein their value lies; and then one must have a broad understanding of human nature to appreciate the needs of the customer, in order to render the service that only a specialist can offer; while one must also possess the tact and

courtesy that will win the confidence of the buyer to become a permanent customer.

Becoming an expert on a manufactured article is fascinating work. The clerk reads trade journals, industrial magazines, compares different makes of the same article, talks of their qualities to the manager or owner; nor does she lose interest in the goods after they are sold, but remembers the names of her customers—a valuable training which yields large dividends in itself—and inquires of them later how their purchases are standing the test of time. Such an enterprising clerk is also able to inform her employers what the public opinion of such goods is, and why certain others did not suit the purchasers, and in this way she is able to advise about the future buying of stock. She also studies the purchasing mood of the public, when it is best to offer certain goods for sale, how her own and rival stores compare in results from window displays and advertising, and supplies the information when a certain line is nearly exhausted and should be renewed. When a clerk enters into the business in such an earnest manner, the time soon comes when she feels that many customers have become her own, and would patronise her should she start a small business at a new stand; but the probability is that her employer, rather than lose such a valuable assistant, will offer her a partnership in the business, and make money in so doing.

The Stenographer.—Before becoming a stenographer a girl should complete her high-school course, as the more education she has before beginning, the easier it is to complete her year at business college, and the more valuable is her work to her employer. When she has gained sufficient experience, a stenographer should secure, if possible, a position with a large firm or corporation, like an insurance company or railway, where there are certain chances of promotion. A business course will cost a stenographer at least two hundred dollars, and then she is not always certain of a position, but may have to wait for an opening, and in the meantime, with loss of practice, her speed drops. But hope springs eternal in the human heart; the business depression passes, new enterprises are undertaken, or she hears of a stenographer who is about to resign her position in order

to be married, and hurries to offer her good wishes, and to ask for the position soon to be vacant. So the two visit the manager, with the result that the next week the young stenographer is working for $80 a month, and planning the clothes that she will buy with the money.

A stenographer who enters a business that has a future can make herself indispensable to her employers by studying their interests from every angle. As she takes the correspondence, she has a remarkable opportunity of becoming conversant with the business in every particular, and the scope of her work depends entirely upon the ability she possesses.

Whether one is a college student, teacher, or is working in any business capacity, the use of the typewriter is so necessary to-day that a course in typewriting is very popular in night-school classes for those otherwise employed during the day.

The Teacher.—Teaching school is one of the easiest occupations if one knows how to make it a success, but the most impossible of all if one does not. When summer holidays begin every other worker envies the teacher, but when the fall term opens they all offer her their consolations. There is no work more important than that of training the young, and the teacher's influence is second only to that of the parents. To become a teacher one must take the regular course through the high school, become a graduate by passing the Government examination, and then spend a year at the normal school. The working hours are short, the number of teaching days is only about two hundred a year, employment is regular, the salary is certain, and compares favourably with that of any other employment that a girl may enter, but the disadvantages also are many. Much time is demanded outside of school hours to prepare the next day's work, and to mark tests, while the strain of preparing pupils for examinations is wearing in the extreme. A teacher cannot help worrying over the pupils that make slow progress, and the care of so many children with different dispositions is a great responsibility. If one has a keen understanding of the child mind, and an earnest sympathy for those little ones who are just finding their way in the great world, where so much depends upon the start, there is no nobler

work, nor any in which there is a greater opportunity to serve, than that of teaching.

The Nurse tells her own Story.—I am a nurse. There are many easier ways of earning a living than the one I have chosen, but few that give one a better opportunity to serve the needs of humanity. We sense the realities of life, and see the human soul revealed, when worldly influences lose their effect in the shadowland of sickness, suffering and death. Even as a child I had the instinct of a nurse; I visited the sick and carried them flowers, listened patiently to the lengthy tales of the afflictions of elderly people, loved to open and smell the odours of medicine-bottles, and bandaged my doll for various ailments.

After graduating from high school, I entered the hospital for training as a nurse, receiving no pay until I earned my cap after four months' service. It was then three years before I graduated, and during that time my wages were $6 a week for the first year, $7 for the second, and $8 for the third year. My hours of duty were from seven to seven, with two hours off during the middle of the day. I learned to scrub floors properly, to change a bed without removing the patient, to mark a temperature chart, and much other practical knowledge that a nurse needs to possess. There were evening lectures to attend on physiology, medicine and surgery, and books to read for examination work. After graduating, I was given regular work in the hospital, where I earn $35 a week, with board and room free. My work is divided into eight-hour periods, some of these being assigned to night duty.

What would our people do without the modern hospital? Through the generosity of public donations, aided by Government and civic assistance, none that are prostrate with sickness are turned from its doors. There they are born, return later as children with such infectious diseases as scarlet fever and diphtheria, visit us again to have tonsils and adenoids removed, and then trust that they are done with the hospital for ever. But with the passing years, in an unguarded moment, they are the victims of an auto accident, or meet with some other disaster. Bundled into an ambulance, they are rushed to the hospital, where, with calm efficiency and dispatch, their

lives may be saved by a matter of seconds. In the last great struggle, from which no one emerges victor, they again seek the sanctuary of the hospital, and it is the sad duty of the nurse to close their eyes in death.

My sister-nurses of the Red Cross, which is supported largely by the efforts of school-children, minister to the sick in the lonely outposts, and give medical care to the newly arrived immigrants. Among the pioneers of the wild they pursue their lonely calling, meeting the gravest emergencies alone, with human life at stake, their only reward being the heartfelt thanks of those to whom they have yielded such noble service.

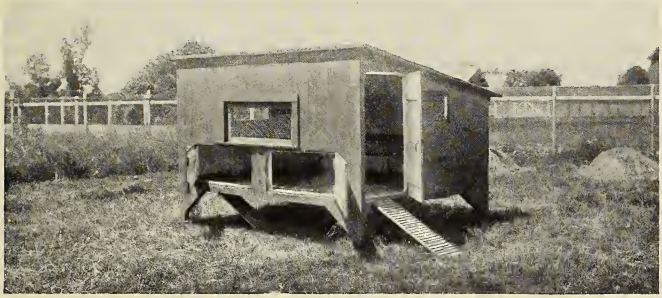
My great ambition is to be head nurse of a ward, and after that, perhaps, matron of a hospital. I have talked freely of our work for the guidance of any schoolgirl who, with a sympathy for human suffering and a willingness to do strenuous work, has an aptitude for nursing.

77. EMPLOYMENT FOR BOYS

Farming. — Farming is the most important occupation in Canada, and upon it most of the other industries and the prosperity of the country depend. It is healthful, interesting and natural work, appealing to us all, for the desire for land is an inheritance of the race.

The boy that has the best prospect of success in this enterprise is the one who is reared on the farm. A city lad usually has very little knowledge concerning his father's business; but the boy on the farm, from an early age, helps to care for the stock, teams the horses, and learns to hoe, weed and gather the crop. A farmer is delighted when his sons evince a desire to stay on the land, and is usually willing to help them purchase farms in the district, and lend them teams and machinery until they are started. Such a boy is fortunate indeed if he is able to take a course at an agricultural college, where he learns the latest and most improved methods of farming and obtains expert knowledge concerning stock and crops.

There has never been a better chance than at the present time for a city boy to become a farmer, even though the chance for free homestead-land is practically past; but he must be willing to work hard during long hours in the summer, and be content away from city amusements. The great advance in wages in recent years, and the scarcity of help, have so seriously handicapped the farmers, that those whose sons have sought their fortunes in the cities have great difficulty in carrying on in their advancing years. In five years a bright and willing boy, by the time he is twenty-one, could save $2000 in wages,



Department of the Interior

A MODERN POULTRY-HOUSE

Farming is now a scientific process carried on under sanitary conditions. See also the modern dairy pictured on page 51.

and at the same time learn to farm successfully. He would then have a good prospect of buying or renting a farm with his capital. A boy with such a record for saving can readily borrow money from a bank for any sound business proposition, and if he has saved money during the most tempting years for spending, his business career is assured.

Untold opportunities await the farmer who has a desire for investigation, and some marked successes have already been made by intelligent young men new to the business. The improvement of seeds to produce better varieties and heavier yielding crops is a fascinating business. While great strides have been made in this direction, there is no limit to the

possibilities, and the sale of certified seed is the most profitable part of farming. The person who produces a seedless apple, or finds a way of eradicating wheat-rust, will be entitled to a million dollars. Surely the occupation of farming is worth the consideration of every boy.

Trades.—The system of learning a trade in Canada differs from that in England, where the boy begins as an apprentice, and pays to be taught his trade as he works. When his apprenticeship is finished, he knows his one trade thoroughly and well, as we have reason in our country to know, where so many of the mechanics are from the British Isles. But in Canada, when a boy wishes to become a carpenter or a painter, he is first employed by a contractor as a helper, and paid wages from the start. As soon as he has made good, he buys his full set of tools, and joins the trade union.

The educational field is being extended to assist the boy in learning a trade, by the establishment in large centres of technical schools, where the essentials of a trade are taught in a scientific way. Every boy should avail himself of this training before beginning work at his chosen trade.

The Carpenter.—In Canada such a large amount of new building is going forward that carpenters earn good wages, with steady employment during summer months.

There are usually some small jobs in winter, but the idleness during this season is the great drawback to the trade. When one has learned to do every kind of carpenter work, has studied carefully the cost of materials, and has saved a small amount of capital, he may take a contract to erect a building for a certain price, furnishing the material himself. In contracting for houses, he would have to sublet contracts for wiring, plumbing, heating, plastering and painting; so a contractor needs to acquire much knowledge of these other trades. A contractor who gets the name for doing good work, and is honest in the use of material, when so much is covered over with plaster and paint, is certain of steady contracts. He must also be an architect as well, and design new and attractive ways of building. There is a pleasure in seeing a new building rise from its foundations, and in the fitting and joining of new lumber, that

makes the carpenter's work a most pleasant task. It is also a healthful occupation, largely performed in the open air.

Automobile Mechanic.—The universal use of the motor-car, and its frequent need of repairs, has led to a new trade, that of the automobile mechanic. To be successful in this work, one must have the ear of a musician and a technical skill equal to that of a medical doctor, for an automobile has a certain personality, and is much more complicated inside than a human being. When a doctor treats his patients he knows that they are all built on the same model, with the same number of organs situated in the same way, and that Nature in time will assist in the healing, so that the human constitution is far more enduring than the finest machinery made of steel. But the motor-mechanic must know the construction and working of different types of cars, and his ear must detect the contented hum of each that bespeaks the pulsating of perfect machinery in action, or be able to locate the place out of order from the discordant note produced. He must also understand the working of electricity, as it produces the spark which ignites the vaporous gasoline, diluted by air, at the head of each cylinder; and he must know the properties and power of gasoline combustion.

When one has become an expert he may open a garage of his own, employ helpers, and add to his earnings by the sale of gasoline, oil and accessories. In this business honesty and reliability are essential, for few owners understand the working of the delicate yet powerful machinery housed under the hoods of the cars they operate, and have to be guided largely by the verdict of the mechanic. In fact, the car owner has to depend more upon the advice of his garage man than he does upon that of his doctor, lawyer and banker, and the services of the man in overalls may save him often from the need of the other three.

Opportunities in Lumbering and Mining.—To the Canadian boy, no matter what his ability, his intelligence quotient, or his antecedents, there are unbounded opportunities to develop all that is in him by following one of the occupations connected with the development of our wonderful forest and mineral resources. No matter whether he has left school with but a rudimentary and imperfect knowledge of the three R's, or

has graduated with honours from a university, no higher field of achievement awaits him than this. Nor is it always the university graduate who makes the greatest success in these callings that demand native courage, persistent effort, powers of physical endurance and mental initiative: for I have seen a university graduate washing dishes in a logging camp, while a youth, who could not pass the entrance examination after two attempts, was manipulating the controls of the yarding engine.

Canada's timber wealth, with the enlightened policy of conservation that now prevails, will be an unfailing field of employment to the youth of our land. The mineral resources of Canada have been scarcely touched, and the voice of our hills cries out to adventurous youth. No need to seek opportunity in other lands, for ours is the land of opportunity.

Unfortunately, the young man, starting out in search of a career and a fortune, is left at the cross-roads without a guide. He passes by the rough skid-roads that lead to the lumber camps, and the narrow trails that thread their way to the riches of our mountain-sides; for there is the broad highway, trodden by many feet that were winged with hope or weighted with despair, stretching away to the golden cities of the sunny South. When we have co-operative conservation of our man-power, the greatest asset possessed by any nation, there will be friendly hands stretched out to guide the eager but heedless steps of youth.

Industrial Professions.—Many who are not adapted to these strenuous occupations turn to office-work, insurance or banking. They have the sureness of a steady salary, the comfort of inside work, and the privilege, so important to some, of not having to do manual labour. The great disadvantage of this work is that it is being considered more and more the proper sphere for women, which means such close competition that salaries do not compare with the wages earned by mechanics. Even in the conservative business of banking women have advanced to the cashier's cage. The proper preparation for office-work is the commercial course in the high school, or a course in the business college.

Salesmanship, as the selling of insurance on commission,

or selling goods for wholesale houses to the store trade, is a profitable line of business engaged in by men of address and personality.

If one chooses his life's work as soon as possible, prepares for it carefully, loves work for the work's sake, and endeavours to serve others faithfully and well, and is blessed with good health, he will find Canada a land of opportunity, and life an investment yielding rich returns.

78. THE FUTURE OF CANADA

In the life of every man there should be an abiding faith in his own powers to shape his destiny and attain his ideal. When he passes, at last, through the sunset gates, he goes with head erect, fearless and satisfied. In like manner, the life of a nation depends for its success upon the indwelling spirit of its people, their faith in themselves and in their future. Canadians have arrived at the point where nationhood begins to assume world-wide responsibilities. Canada cannot hope to maintain, even if it were thought desirable, that splendid isolation which has been assumed by her elder sister state to the south. For Canada is not, and never can be, self-centred and self-contained, unless her people revert to the ideals of their aboriginal compatriots, the Indians. We, the Canadians of to-day and to-morrow, must open our gates to people of our own race, whatever their language or creed, so long as they are prepared to pledge fealty to our ideals. Our ports must be open to every nation that sends a ship into the seven seas; for we are guardians of Nature's treasure-chests, the few that remain unrifled on this continent, the treasures of soil and sea, of forest and mine.

We shall not hoard this wealth, as a miser his gold: we shall safeguard it for the good of all mankind, as a banker protects the nation's securities against thieves and spendthrifts. But we have still other treasures to guard—treasures of conceptions and ideals, handed down to us, not alone by the fathers of confederation or by the splendid spirit of Frenchman and Briton who founded our country, but by the blended hopes, inspirations and ideals of a common humanity.

EXERCISES

WHAT CANADA NEEDS

1. Immigration. New settlers will flock to our country as we need them. The two periods when we received the most were during the construction of the Canadian Pacific and Canadian National Railways. They are coming at present in steady numbers to participate in the progressive prosecution of our industries that is now being undertaken.

2. A system of reafforestation to provide for the lumber and pulp industry of the future.

3. Foreign trade developed in the Orient and South America for our manufactured goods.

4. The opening of the Peace River country.

5. The refining of minerals, like copper, before they leave the country and an electrical process for the making of iron and steel.

6. Cheaper fuel for aeroplanes.

7. A cement for roads that will harden in less than a month.

8. A remedy for wheat-rust.

9. A national spirit that will make every citizen proud to be a Canadian.

10. A coming generation who will find their pleasure in work.

GENERAL TESTS AND PROBLEMS

Superlative Test on Canada

Name the most important:

1. Export.
2. Market for our lumber.
3. Import from England.
4. Farm animal.
5. City west of Ontario.
6. Fish.
7. Mineral.
8. Variety of wheat.
9. Mining town in British Columbia.
10. Animal of the fur farms.

11. Bridge (in respect to size and cost).
12. Import from China.
13. Province for manufacturing.
14. River system.
15. Tree for pulp.
16. Province for cheese.
17. City situated on a lake.
18. Month for plant growth.
19. Food.
20. Country for our export trade.
21. Breed of cattle for beef.
22. Province for fur farming.
23. City north of the fiftieth parallel.
24. Means of travel.
25. Business conducted by the Government.

Elimination Test

In each group mark one not having a quality common to the others. Readers may refer to school geography or other reference books.

1. Cedar, fir, yew, ash, pine, hemlock.
2. English, Irish, Scottish, Hindu (settlers).
3. Fox, muskrat, mink, bear, deer.
4. Regina, Prince Rupert, Port Arthur, Toronto, St. John.
5. Miner, farmer, carpenter, fisherman, lumberman.
6. Cod, herring, lobster, salmon, pike, halibut.
7. Red River, St. John, Moose, Nelson, Fraser, Skeena.
8. British Columbia, Saskatchewan, Manitoba, Ontario, New Brunswick.
9. St. Maurice, Bridge River, Niagara, Restigouche, Rideau.
10. Fort William, Fort Norman, Fort MacMurray, Fort Chippewyan, Fort Vermilion.
11. Lakes Erie, Michigan, Athabaska, Lesser Slave, Huron.
12. Bluejay, wren, robin, meadow-lark, swallow.
13. C.P.R., C.N.R., G.N.R.
14. Wasp, ant, spider, bee, fly, beetle.
15. Agriculture, fishing, minerals, lumbering, manufacturing.
16. North Bay, Prince Albert, Kenora, Nelson, Hamilton.
17. Lynn Canal, Portland Canal, Alberni Canal, Welland Canal, Murray Canal.

18. Richelieu, Assiniboine, Fraser, Kootenay, Liard, Peace.
19. Robson, Donald, Brown, Logan, St. Elias.
20. Trail, New Glasgow, Nanaimo, Fernie, Sydney.
21. French River, Slave, Niagara, St. Mary's, Rainy River, Athabaska.

Industries of Canada

Put an X opposite the most correct statement in each.

1. Agriculture is the most important industry because:
   (*a*) The most people are employed in it.
   (*b*) Food is a necessity of life.
   (*c*) The soil and climate are favourable for crops.
   (*d*) New inventions make farming easier.

2. Lumbering is on the increase because:
   (*a*) The world's supply is limited.
   (*b*) Canada has valuable lumber resources.
   (*c*) There is a great demand for paper pulp.
   (*d*) The land needs clearing for crops.

3. Ontario is the most important province for manufacturing because:
   (*a*) It was the first to manufacture.
   (*b*) It is in the centre of Canada.
   (*c*) It has an abundance of useful metals and hardwood.
   (*d*) Its people are more enterprising.

4. British Columbia leads in fishing because:
   (*a*) It has a long sea-coast.
   (*b*) It has many long rivers.
   (*c*) The salmon is native to its waters.
   (*d*) Many people are engaged in the industry.

5. Canada could support fifty million people because:
   (*a*) United States supports twice that number.
   (*b*) Nine-tenths of its natural resources are not yet used.
   (*c*) People could live on less than they do now.
   (*d*) Many settlers are anxious to come to Canada.

6. Canada is rich in minerals because:
   (*a*) It has many mountains.
   (*b*) The mines have only been worked for a short time.
   (*c*) The world's supply of minerals is limited.
   (*d*) Nature has endowed Canada with valuable ores.

7. Many immigrants are coming this year because:
   (*a*) Europe has been unsettled since the war.
   (*b*) The need for settlers has been advertised abroad.
   (*c*) The government has changed.
   (*d*) Low fares are granted immigrants to Canada.

8. Manufacturing will increase because:
   (*a*) Canada has a great supply of raw material.
   (*b*) Boys in cities can attend technical schools.
   (*c*) People are using more manufactured goods.
   (*d*) The duty is likely to be kept on goods from other countries.

9. More people should live on farms because:
   (*a*) Most of the farmers own their own lands.
   (*b*) They can supply most of their needs.
   (*c*) Inventions like the radio are making country life pleasanter.
   (*d*) All the family have to work.

10. An intelligent boy should stay in Canada because:
   (*a*) The country needs his services.
   (*b*) There is bound to be big development in the future.
   (*c*) He can live at home if he does not secure employment.
   (*d*) It costs the country $5 to get an immigrant to take his place.

From the list below select the right cities for filling in the blank spaces.

1. —— is the greatest inland port in the world.

2. The largest cheese-exporting centre in Ontario is ——, which has a population of 12,803 and contains one of the finest cold-storage plants in Canada.

3. —— is the live-stock centre of Saskatchewan with the greatest stockyards west of Winnipeg. It is the divisional head-quarters of the Canadian Pacific Railway and contains the Robin Hood Mills, whose daily output is 5000 barrels of flour and 2000 cases of rolled oats.

4. One of the largest dry docks in America is at ——, whose harbour ranks third in the world for size and safety.

5. —— is the centre of the new oil district and is the gateway of the Rockies.

6. The largest plough works, wire fence and agricultural imple-

ment works in Canada are in ——, which is the third industrial city in the Dominion.

7. —— is the gateway to the Peace River country and the Mackenzie Basin, and contains a dairy with the largest output in Canada.

8. —— is the city where the telephone was invented by Dr. Bell in 1874, and is the fourth city in Canada in exporting manufactured goods.

9. —— has the finest harbour, with 20 miles of water-front, and is the gateway to the Orient.

10. ——, with 23 natural gas wells, is a very progressive industrial centre, producing flour, clay products, linseed oil, pottery and coal.

11. The fourth city in population in Ontario is ——, with 70 lines of manufacturing and 232 plants.

12. —— is the centre of Canada's greatest iron and steel and most important coal-mining industries.

Hamilton	Montreal	Halifax
Brantford	Sydney	Vancouver
Belleville	Calgary	Moose Jaw
London	Medicine Hat	Edmonton

Valuation Test

Arrange the names in each question in order by placing 1, 2, 3, 4, etc., over the name that should be first, second, third, fourth, etc. Readers may refer to school geography or other reference book.

1. (*Size*) Winnipeg, Vancouver, Montreal, Toronto, Ottawa.

2. (*Size*) Superior, Huron, Erie, Ontario, Athabaska.

3. (*Size*) British Columbia, Alberta, Ontario, Quebec, Saskatchewan, Manitoba.

4. (*Importance*) Lumbering, agriculture, mining, fishing, manufacturing.

5. (*Length*) Mackenzie, St. Lawrence, Yukon, Saskatchewan.

6. (*Age*) Toronto, Kingston, Montreal, Halifax, St. John.

7. (*Coal*) British Columbia, Saskatchewan, Alberta, Nova Scotia, New Brunswick.

8. (*Water-power*) Manitoba, Quebec, Ontario, British Columbia.

9. (*Time of ripening*) Wheat, oats, barley, flax.

10. (*Population*) Quebec, British Columbia, Ontario, Nova Scotia, Saskatchewan, Alberta.

11. (*Shipping*) Montreal, Halifax, Quebec, Vancouver, St. John.

12. (*Altitude*) Regina, Calgary, Toronto, Vancouver, Montreal.

13. (*Yearly value*) Lobsters, cod, salmon, herring, halibut.

14. (*Value of pelts*) Bear, seal, otter, mink, silver fox, muskrat, beaver.

15. (*Distance from ocean*) Kamloops, Fredericton, Prince Albert, Toronto, Cobalt.

16. (*Amount*) Pine, Douglas fir, spruce, red cedar, hemlock, poplar.

17. (*Value*) Gold, copper, silver, zinc, coal, lead.

18. (*Time of ripening*) Apples, pears, plums, cherries, blueberries, cranberries.

19. (*Time of entering confederation*) Ontario, Prince Edward Island, British Columbia, Manitoba, Saskatchewan.

20. (*Number entering Canada since* 1901) British, Americans, Japanese, Austrians, Hebrews, Italians.

Vocabulary Test

Underline the most suitable meaning for each of the words below:

Chapters 1–4

Cereals (breakfast foods, continued stories, grains, products of the earth).

Posterity (ancestors, descendants, relations, people).

Totems (sign-posts, graveyards, inscriptions, picture-carvings, sign-boards).

Disseminate (to spread, to seed, to widen, to instruct, to continue).

Alchemists (druggists, scholars, wizards, experimenters, scientists).

Aboriginal (first, early, native, tree-dwellers, Indian).

Barter (buy, sell, trade, haggle, give).

Hieroglyphics (drawings, paintings, picture-writings, sacred picture-words).

Symbolic (alphabetic, resembling, allegorical, interpretative, emblematic).

Chapters 20–21

Gravity system (system of weighing, flowing down-hill, drawing power of the earth, water seeking its own level).

Subsidiary (branch, bonus, underlying, fed, distributed).

Laterals (late-arrivers, side-lines, branches, feeders, protuberances).

Flume (aqueduct, bed, tunnel, pipe, canal, raised water-conveyance).

Tilth (hoeing, cultivation, dirt, renewing, preservation).

Semi-arid (dry, parched, desert, watered, partly watered).

Fumigate (spray, dust, treat for germs, wash, cultivate).

Parasite (situation, insect, fungus, guest, organism, organism living on a host).

Entomology (disease of plants, medicine, study of insects, habits of life).

Insectivorous (destruction of insects, attacked by insects, desired by insects, devouring insects).

Chapters 22–3

Adaptation (modification, change, enlargement, reconstruction).

Unpalatable (pertaining to the mouth, unsociable, indigestible, distasteful).

Excrescence (addition, outgrowth, exudation, increase, decrease).

Collaborated (worked in a laboratory, assisted, harmonised, developed, compiled).

Asset (debt, credit, risk, stock, advantage, aid).

Criterion (judgment, opinion, guess, belief, statement, test, standard).

Exploitation (use, achievement, using for selfish purposes, demolishing).

Geologist (naturalist, scientist, one who studies rock formations, geographer).

Proximity (nearness, distance, neighbourhood, proxy, immediate nearness).

Chapters 24–7

Magnitude (dimensions, size, bulk, enlargement).

Hydraulic (pertaining to water, water-power, electric-power, gold-mining).

Aroma (a wanderer, instinct, medicine, lotion, flavour, perfume).

Stampede (round-up, rodeo, rush to the gold-diggings, sudden movement).

Alluvial (sweet-smelling, deposited under water, pertaining to dirt, sedimentary).

Rôle (the playing of a part, position, something folded, a package of paper).

Consummation (desire, work, hope, devouring, fulfilment of a desire).

Adroitly (expeditiously, skilfully, quickly, cunningly).

Impetus (movement, impediment, assistance, force of motion).

Syndicate (company, organisation, promotion, association).

Residue (dwelling, remains, gum, process).

Chapters 31–5

Intrinsic (internal, essential, familiar, exceptional).

Premonition (symptom, warning, desire, recompense, previous warning).

Insatiable (unquenching, greedy, incapable of being satisfied, unhealthy).

Perpetuation (continuation, extension, repetition, eternity).

Cupidity (love-making, desire, greediness, anxiety, desire for wealth or power).

Specific gravity (customs duty, definite weight, seriousness, the weight of a body compared with an equal volume of water).

Inception (receiving guests, inauguration, perception, establishment).

Vogue (whim, wish, custom, music).

Consistency (content, connection, portion, degree of density).

General Problems

1. Of the total land area of Canada, 3,650,000 square miles, about 1,277,000 square miles are covered with forests. Only 40 per cent of this is merchantable timber, 6 inches in diameter, and 20 per cent is saw timber, 10 inches through, the remainder being young stands which have come up after fire or burning.

(*a*) What per cent of the country is covered by forests?

(*b*) What per cent is covered by young stands of forests?

(*c*) How many acres of saw timber does Canada possess?

(*d*) For what purpose is timber less than six inches through marketed?

2. The saw timber is equal to that of one stick, 2 feet square and 1,900,000 miles long. How many board feet would it contain?

3. The annual values of the primary products of the forest are:

Logs and shingle-bolts for mills	$80,000,000
Pulpwood	$60,000,000
Firewood	$40,000,000
Railway ties	$14,000,000
Mining timber	$ 3,000,000
Fence-posts, rails, special uses	$ 3,000,000

What percentage of the total value has each product?

4. Number of sawmills (1925) . . 2,700
   Employees 35,458
   Wages and salaries . . . . $ 34,097,006
   Products $134,413,845

(*a*) What is the average yearly production of each sawmill?

(*b*) What is the average annual earning of the employees?

(*c*) How much does each dollar invested in wages produce in lumber?

(*d*) What is the average number of people employed by each sawmill?

5. Mill products (1925):
   Sawn lumber $99,725,519
   Shingles $10,372,735
   Laths . . . . . $ 6,160,976
   Railway ties . . . . . $ 3,474,944

(*a*) What is the combined value of the mill products not listed? (See also previous question.)

(*b*) What per cent do the shingles make of the total mill production?

6. Times have changed since the days when women preserved the yearly supply of fruit at home. This work is now largely done by the canning factories, which at present number 242 and are situated in the three great fruit belts of Canada. In 1925 they produced canned goods valued at $22,376,313. Counting the population as 9,000,000, what would be the average consumption of canned fruit and vegetables for a family of five?

7. Sixty per cent of the average catch of fish is exported, the United States taking one-third and Great Britain one-fifth. If the domestic consumption is 22 lb. *per capita* and Great Britain in 1926 imported fish from Canada amounting to $7,264,516: (*a*) what was the total value of fish taken that year? (*b*) how many tons did the catch weigh? and (*c*) what was the average value per pound of the fish?

8. Canada has 385,000 miles of highways. The Dominion aid has been about eighteen and a half million dollars to date, representing 40 per cent of the cost. What has been the average cost of each mile of highway?

9. In 1890 the area under field crops for all Canada was 15,662,811 acres. In 1926 it was 56,927,371 acres. What per cent has farming increased in Canada during the past thirty-six years?

10. Canada issues thirty-one million dollars' worth of postage-

stamps yearly. Counting the population as 9,000,000, how many letters at 2 cents each would this amount to of postage mail on an average for each person?

11. The telephones in Canada to-day have a wire mileage of 3,000,000 miles. How many telephone wires would this amount allow between the earth and the moon, a distance of 240,000 miles?

12. In 1926 Canada produced 90 per cent of the world's supply of nickel, 85 per cent of the asbestos, 55 per cent of the cobalt, 9 per cent of the gold, 8 per cent of the silver, and 4 per cent of the copper. Canada's production in round numbers:

Gold .	$38,000,000	Silver .	$14,000,000
Copper	$17,000,000	Asbestos	$10,000,000
Nickel .	$14,000,000	Cobalt .	$ 1,000,000

(*a*) In what minerals does Canada lead in the world's production?

(*b*) Tabulate the value in dollars of the world's production of the six minerals listed above.

13. If Canada's mineral production in 1926 was $241,245,898, or an average of $25·69 *per capita*, what was the exact population of Canada in that year?

14. The war increased the public debt of Canada about two billions of dollars. It was largely subscribed by the Canadian people, and, as it is reduced, the money does not leave the country. On an average, how much did each person subscribe?

15. If 30,000,000 lobsters are taken yearly, find from the table on page 151 the average value per lobster.

16. A large pulp-mill turns out news-print paper in a continuous sheet, 20 feet wide, at the rate of half an acre a minute from a single machine.

(*a*) In ten hours how many acres of paper would it produce?

(*b*) How many lineal feet of paper would such a machine produce in one minute?

17. Canada leads the world in railroad mileage *per capita*. The railways use 30 per cent of all the coal consumed in Canada. The total steam-railway mileage in operation is 40,352. How many feet of railway would there be *per capita*?

18. If the eggs from hen No. 6, U.B.C., sell for $25 each for hatching purposes, what would her record production for a year of 351 eggs have been worth at that rate?

19. The value of pelts sold from fur farms in 1925 was $781,383, or 4 per cent of the total value of furs for that year. What was the value of the pelts taken that year from wild animals?

20. The total mileage of aircraft increased from 185,000 in 1922 to 393,000 in 1926. What was the average yearly increase?

21. How many square miles in Alberta are under irrigation?

22. With a fall in the flume of one inch in twenty-five feet, how many feet would the water fall in travelling two miles?

23. What percentage of the irrigated lands of Alberta is operated by the Canadian Pacific Railway?

24. Canada produces 50 per cent of the world's supply of maple sugar and 95 per cent of Canadian sugar comes from the Eastern Townships. What per cent of the world's supply of maple sugar does the rest of Canada furnish?

25. One cord of hardwood weighs 3700 lb. When distilled, it yields 1000 lb. of charcoal, 16 gallons of wood alcohol and 200 lb. of acetate of lime. How many tons of charcoal would a pile of hardwood 28 feet long, 8 feet high, and 16 feet wide, furnish?

26. How many gallons of wood alcohol would be furnished by the pile of wood in the above question?

27. In making wood-pulp, what fraction of a cubic inch is the "ideal chip"?

28. If sulphurous acid has practically the same weight as water, what per cent of the "cook" is wood, if ten tons of dry chips are used?

29. What per cent of moisture has been lost from the time the stock leaves the "jordan" until it reaches the "calendar stack"?

30. What is the value of the news-print a ton?

31. By what per cent did the fishing industry increase in value from 1870 to 1925?

32. What is the value of the fish exported to Great Britain?

33. What per cent of the value of his equipment is the average earnings of a fisherman?

34. What has been the average annual increase of furs in Canada between 1910 and 1926?

35. By how many land miles is Montreal nearer to Liverpool than is New York?

36. How many tons of water were contained in one of the old wooden locks of the Welland Canal?

37. If the Canadian gold dollar weighs 25·8 grains and contains 23·22 grains of gold, what fraction of other metal does it contain?

38. How much did the British Government spend in 1925 and 1926 in settling British families in Canada?

39. From the total sale of wheat and the average income per family, find the population of the Prairie Provinces.

40. In 1926 the value of buildings constructed in Canada was $156,000,000. How many people, with an average family of five, would this sum provide houses for, averaging $3200 each in cost?

41. If, in making concrete, cement and sand are mixed in the proportion of 1 and 4, and a barrel of cement contains 3·8 cubic feet, how many barrels of cement and cubic yards of sand and gravel will be required to construct a wall 160 feet long, 18 inches thick, and 6 feet high?

42. A forty-foot log of Douglas fir is squared to 4 feet in diameter. Half of it is cut into shiplap 8 inches wide, 1 inch thick. The rest is cut into lumber for studding, measuring 2 inches by 4 inches. If 20 per cent is lost or wasted in the cutting, how many board feet of shiplap and 2 by 4 lumber are produced from the log?

43. A lake has an area of 1·75 square miles. It has an average depth of 16 fathoms. How many imperial gallons of water does the lake hold?

The total available water-power in Canada is estimated to be 41,000,000 horse-power, of which 10·5 per cent has already been utilised. The total water-power developed during the year 1926, by provinces, was as follows: Quebec, 168,000 horse-power; British Columbia, 45,800; Manitoba, 43,200; Ontario, 5700; and New Brunswick, 2600. If the development of our water-power continues at the same rate, how long will it take to use up 50 per cent of the present available water-power?

44. The land area of Canada is 3,650,000 square miles. The water area is 140,000 square miles. If 40,000 square miles are mapped annually by means of aerial photography, how long will it take to complete the aerial mapping of Canada?

45. How many miles apart, by following the road, are the homes of two farmers in Western Canada, if one's farm is the S.E. half sec. 17, township 12, range 6 west of 2, and the other's is N.W. quarter sec. 32, township 24, range 21 west of 2?

N.B.—Answers to many of these questions are to be found in the body of the text.

GLOSSARY

abattoir: a public slaughter-house.
abrasives: substances used in cleaning, polishing or wearing down surfaces.
alchemist: one who tried to make gold out of baser metals and to discover the elixir of life.
alluvial gold: see *placer gold.*
annual precipitation: depth of rainfall, including melted snow, that falls in a year.
anthracite: a very hard, compact coal.
apache: the Parisian apache is a cunning and bloodthirsty criminal.
argillaceous: consisting of or containing clay.
assay: the analysis of an ore to find the kind, amount and value of the metals it contains.
astrologer: one who professed to foretell events by the position of the stars.
bacterial decay: decay resulting from the presence of microscopic forms of plant life known as *bacteria.*
ball-mills: mills employing metal balls for grinding rocks.
barnacle: a small crustacean that becomes fixed to rocks or to the bottom of ships.
bauxite: a mineral containing a large percentage of alumina; used in the manufacture of aluminium and as a flux.
bolts (lumbering and saw-milling): short logs.
bonanza (mining): a rich strike in a mining-field.
booming ground: where the logs are made up into booms or rafts.
brûlés: burned-over areas.
bucked: cut into logs by means of long cross-cut saws.
bullion: the gold or silver melted down into bars or bricks.
cache: a place, often a hole in the ground, where provisions or supplies are hidden.
carnivores: flesh-eating animals.
choked: fastened by a short piece of cable, called the *choker.*
chronometer ratings: chronometers are very accurate timepieces; but even the best of them will vary slightly, and the amount of this variation is known as their *rating.*
chrysalides: insects in the dormant or pupa stage.
chute: (1) the chief mineralised portion of a vein; (2) a pipe or shaft through which ore is passed to a lower level; (3) in logging, an inclined runway for logs.
city datum: an assumed elevation to which all levels are referred.
coke: coal deprived of its gaseous substances by the application of heat.
collateral: deeds or other securities deposited as an assurance that financial obligations will be met.
concentrates: the ore after it has been treated by various processes to get rid of the worthless matter.
conifers: evergreens, such as pine and spruce, that bear cones.
coracle: a small oval rowboat used by the Celts.
corked boots: boots having numerous spikes in the soles to give the river-drivers or boom-men a grip on the logs.
coulée: valley formed by rivers. A western term.
cribs (lumbering): huge bundles of logs bound with wire cable.
crome: a new tanning process based on the use of acids.
cross-cuts: short tunnels driven from the levels to the vein or ore body.
crustacean: an animal, such as a crab or lobster, having the skeleton in the form of an outside shell.
cultus: a word applied in the West to anything that is utterly worthless.

cuneiform: applied to inscriptions in the wedge-shaped characters used by the ancient Assyrians.
current meter: a gauge for measuring the velocity of streams.
cyanided: treated with cyanide of potassium to collect the gold.
deciduous: a term applied to trees that shed their leaves in the fall.
demulcent: soothing.
detritus: the loose, broken rock at the foot of a cliff or rock-face.
differential calculus: a branch of higher mathematics dealing with infinitely small variations.
double-bitted: applied to an axe having two cutting edges.
edger: a machine for ripping off the uneven edges of planks.
electro-chemistry: a branch of chemistry in which chemical changes are brought about by the use of electric energy.
electrolytic process: deposition of gold or other metals by means of electricity.
electro-metallurgical: applied to the extraction of metals from ores by means of electric energy.
erosion: the wearing away of soil or rock by the action of water or ice.
escarpment: a precipitous bank or nearly vertical face of rock.
fauna: animal life.
float: a piece of rock that has broken away from a vein and has been carried downstream by floods.
flora: plant life.
fluxes: mineral fluxes are substances which assist ores to fuse or melt.
focal axis: a line drawn from the centre of the lens to the point where the rays of light passing through the lens come to a focus.
gangue: the vein stuff of a lode, in which the mineral matter is embodied.
glory hole: a very rich pocket in a mine.
grebes: water-birds commonly known as dabchicks or divers.
grub-stake: money or goods advanced to a prospector to outfit him for a season's work in the field.
habitant tobacco: tobacco grown and smoked by the *habitants* of Quebec.
habitat: the place or environment most suited to a species, whether plant or animal.
hieroglyphics: picture-writing of the ancient Egyptians.
hopper: a movable box into which grain is emptied in an elevator for weighing purposes.
horse-power: a nominal horse-power is the power capable of raising a weight of 33,000 lb. the height of one foot in a minute.
housing: casing.
hydration: chemical union of a substance with water, as occurs in the slacking of lime.
hydraulic jack: a tool used for lifting weights by using water-pressure.
hydraulic machinery: machinery that employs water-pressure to produce power.
imago: the adult insect.
insecticide: a poison employed to kill injurious insects.
insectivorous: feeding on insects.
larva: the grub or caterpillar stage of insect life.
laterals: side ditches of small capacity.
legal tender: authorised currency or medium of exchange.
levels: drifts or tunnels, horizontal passages used in working a mine.
lignite: the poorest quality of coal.
Lloyd's: the greatest marine insurance company in the world.
lodes: mineral veins with well-defined walls.
Luther Burbank: a skilled American horticulturist who improved and developed new strains of fruit and vegetables.
mesa: a flat-topped elevation in western plains and deserts.
metallurgy: process of extracting metals from ores by smelting.

mill-run: output of the mill in sawn lumber.
muffle: a small oven-shaped furnace used in assaying.
oolichan: the candle-fish, much esteemed by the Indians for its oil.
outcrops: where the mineral vein comes to the surface and is exposed to view.
parasite: an insect or plant that feeds on another living creature.
pasteurising: the process of heating milk to kill the germs that cause sourness: named after Pasteur, the French scientist.
peavy: a cant-hook, a spiked tool with a movable arm bearing a hook, used for gripping and turning logs.
penstocks: pressure-pipes that lead the water from a dam or reservoir to the wheel-pits in which the turbines are installed.
physiographic: relating to the natural structure or build of a continent.
pine-tree shilling: an early New England coin bearing a pine-tree engraved on it.
placer gold: pure or native gold occurring as grains and nuggets in beds of sand or gravel.
pot-hunter: one who hunts game for the market.
preferential tariff: a lowering of duty on goods coming from a certain country.
pulpstones: grindstones in the form of large cylinders of sandstone, used in pulp-mills for producing groundwood pulp.
pupa: the chrysalis or dormant stage of insect life.
refractory clays: fire-clays; those that resist great heat.
Riel, Louis: the leader of both the Red River and the Saskatchewan Rebellions.
rock in place: rock that is a part of the solid crust of the earth, not broken up or in the form of boulders.
scaled: measured by the Government scaler to find contents in board feet.
scorifier: a shallow, fireproof vessel used in assaying.
seepage: water that seeps or percolates through the soil.
eigniorial Tenure: the system of holding land which the French introduced into Canada.
shanty: a cabin or shack.
silting: filling up the bed of a stream or ditch by the deposition of sediment.
slurry: the finely powdered rock mixed with water.
specific gravity: relative weight.
stanchions: upright bars for fastening cattle by their necks in stalls.
structural materials: mineral products used in building and other construction work.
stumpage: a tax on every tree cut on a timber limit.
superimposed strata: layers of rock lying above the coal seams.
tailings: the worthless matter left after ores have had their metal contents extracted; in placer mining, the dump of sand and gravel after the gold has been washed from it.
tensile strength: strength that resists tearing or pulling apart.
totems: images or figures employed by the Indians as tribal or family emblems, symbolic of great events and deeds.
tube-mills: mills in which the grinding is done by revolving metal tubes.
turbines: enclosed water-wheels.
vasculum: a cylindrical tin box in which a botanist carries freshly picked specimens.
vitrified pipe: pipe that has been glazed by burning.
yarding point: a point in the woods where the logs are assembled for loading.
Y-level: the telescope rests on two Y-shaped supports.

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